JULY
1960

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# ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

**HOW** catwalk distribution was applied in the new Utica, N.Y., Memorial Auditorium. (page 69)

**HOW** the experts handle aluminum conduit and wire installations. (page 78)

**HOW** system reliability is assured in the new Hampton Roads Bridge-Tunnel. (page 82)

***NEW,*** a continuing feature, "Electric Heating Forum," devoted to discussion of electric space heating practices and problems begins in this issue. (page 88)

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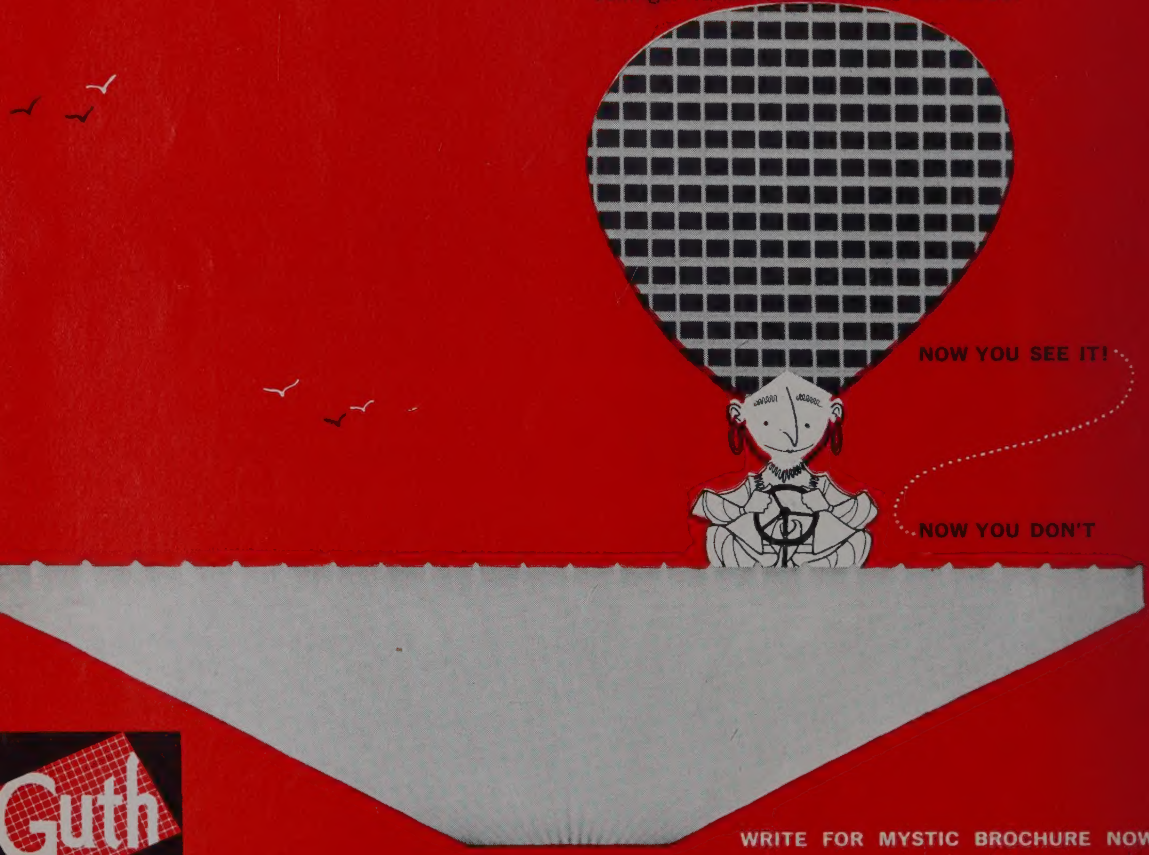

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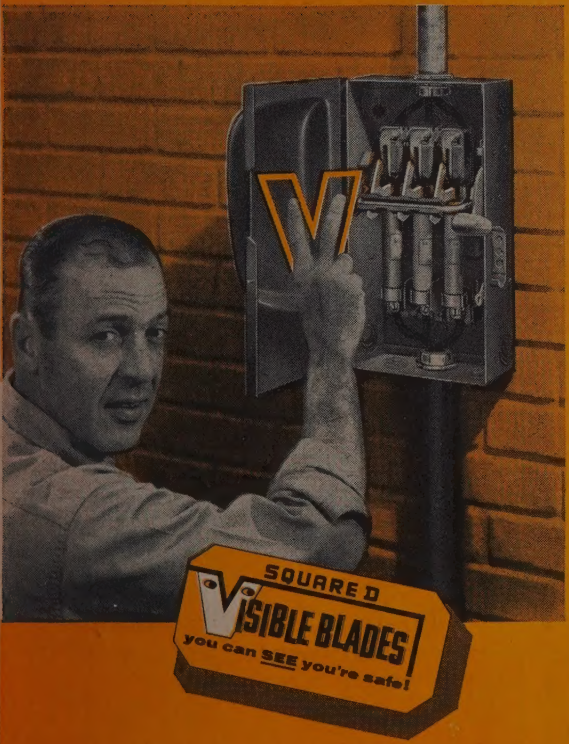

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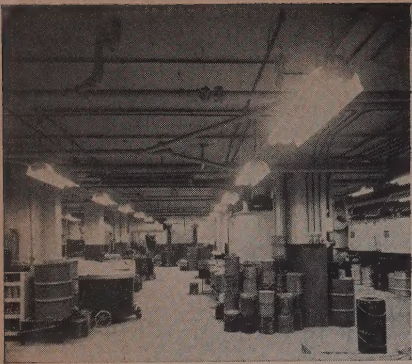

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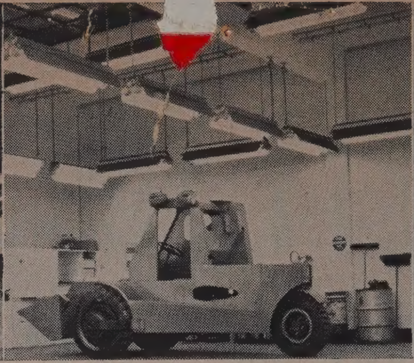

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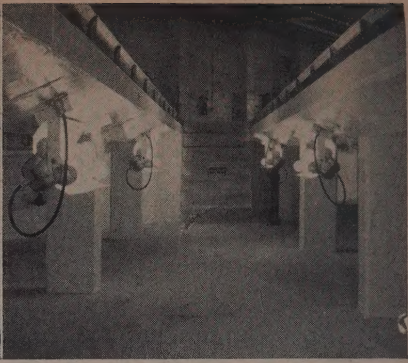

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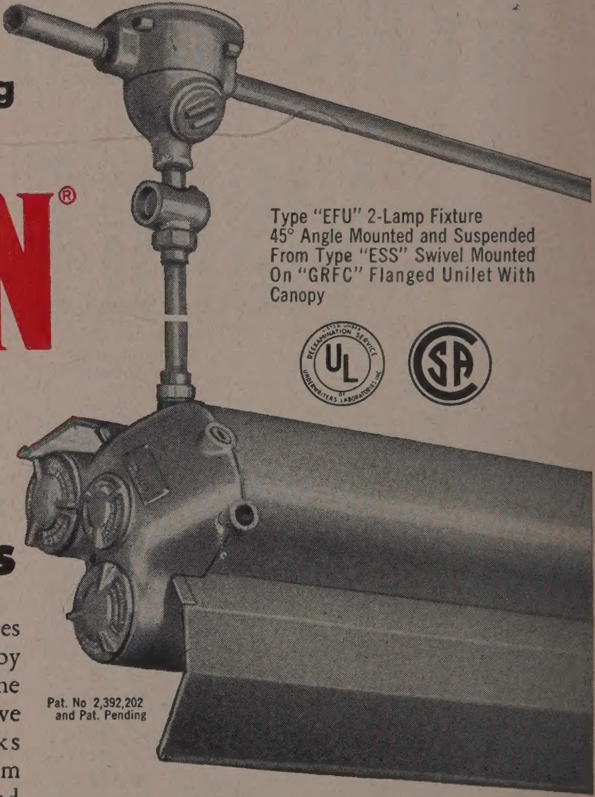

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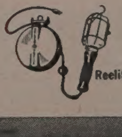

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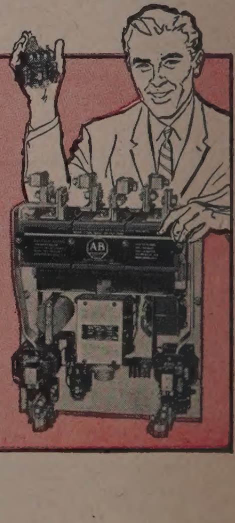

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# Sidelights

## ELECTRIC HEATING FORUM

Along with its continuing growth as a new industry, electric heat has stimulated much research into such related factors as seasonal energy requirements, insulation effectiveness, electrical demand and diversity, and effects of weather conditions. As new experience data are accumulated, new principles emerge; some established concepts take on new forms, others are discarded. To aid in the dissemination of up-to-date heating information, we are opening an Electric Heating Forum (page 88) dedicated to the discussion of new ideas and opinions, operating data, results of research, case studies, problems, and solutions to problems. It is hoped that the material thus presented will be valuable in promoting the understanding of heating principles and practices within the industry. Readers are invited to participate.

## MEDALLION CITY

Impact of the nationwide "Medallion Home" program is now influencing the building of huge city-size projects. In southern California a 4300-home "Medallion City" is said to be the largest development of its kind in the U. S. All homes are wired, appliance-equipped and lighted to electrical Medallion Home specifications, many to all-electric Gold Medallion standards. The project electrical installation is described by Associate Editor H. P. Scott in the article "4300-Home Medallion City" beginning on page 73.

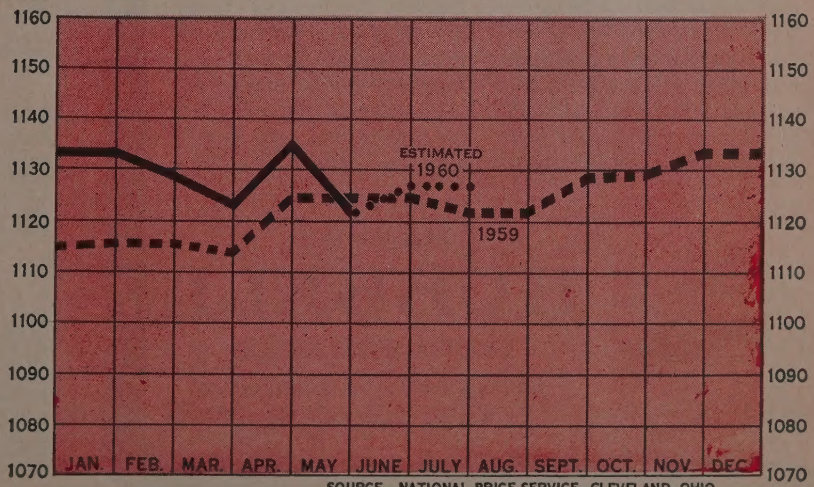
On the opposite coast a new project was started last month in New Jersey with plans for 6000 homes, 5000-apartment units and related construction for a complete Gold Medallion, all-electric community. Plans developed by the firm of W. J. Happel & Co. with the cooperation of the General Electric Company and the Jersey Central Power & Light Co., include electric heat, electric hot water, full housepower and automatic electric kitchens. The community "Electric City" is located seven miles south of South Amboy, and is within commuting distance of New York City.

## CATWALK DISTRIBUTION

Because of an entirely new type of roof construction designed for the Utica (N. Y.) Memorial Auditorium, the engineers were able to develop a novel overhead catwalk system with practically unlimited flexibility in the electrical system. Both power supply to the arena below, which may be used for exhibitions, and the lighting system can be readily adapted to the special electrical requirements of a great variety of shows and other events. Associate Editor John H. Watt describes the details of the electrical installation, by electrical contractors Langdon & Hughes, in "Catwalk Distribution," beginning on page 69.

**ELECTRICAL MATERIALS COST INDEX**

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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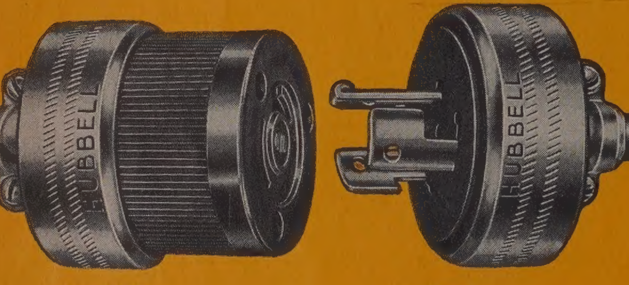

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10 AMPS., 600 VOLTS, A.C.

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Today, "Twist-Lock" is supplied in types, sizes and ratings to fit every industrial and commercial application. Units are available in 2, 3, 4 and 5-wire sizes. Every cap and connector body from 10 ampere to 50 ampere is available with "Seal-Tite" rubber covers for weatherproofing purposes, protection from dust and dirt, or from hard knocks and rough usage. Regular "Twist-Lock" units are supplied grounded and not grounded. Special non-interchangeable grounding types provide protection for 15 ampere, 125 volt or 277 volt applications.

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# engineering news

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Engineering Department

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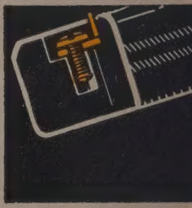
SOLID BRASS MOLDED-IN INSERTS HOLD CONNECTOR BODY TOGETHER SECURELY

**Trouble-Free Wiring**
UPSET BINDING SCREWS CAN'T COME OUT!



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RUGGED STEEL ARMOR PLATE SHELL FOR MAXIMUM PROTECTION AGAINST BREAKAGE

**Adjustable Cord Grip**
HEAVY ADJUSTABLE CORD GRIPS TAKE STRAIN FROM BINDING SCREWS

# Washington Report

JULY • 1960

**The business outlook is less than rosy** to many businessmen, even though national economy guideposts indicate 1960 is a prosperity year. Gross national product, for example, is running at a record high annual rate, but production has not risen as high as had been expected, employment has not advanced in proportion to production, unemployment has remained at higher levels than is usually experienced in prosperous times, and consumer spending has been disappointing even though it has been at an all-time high. In other words, a high plateau is not enough, businessmen and economists believe; continuing growth is necessary and expected.

The second half of this year will be much better, it is believed by many. Consider steel production, for example. It is now down to only slightly more than 60% of capacity, having slid from a 95% of capacity rate early this year. It is expected to pick up, starting next month, as auto makers start buying steel for 1961 models, and as inventories are depleted in other industries and have to be replaced. But the steel industry will probably not exceed a production rate of over 75% of capacity during the balance of this year.

**National economy statistics reflect the current business climate** to some extent and confirm that growth is more or less currently at a near standstill:

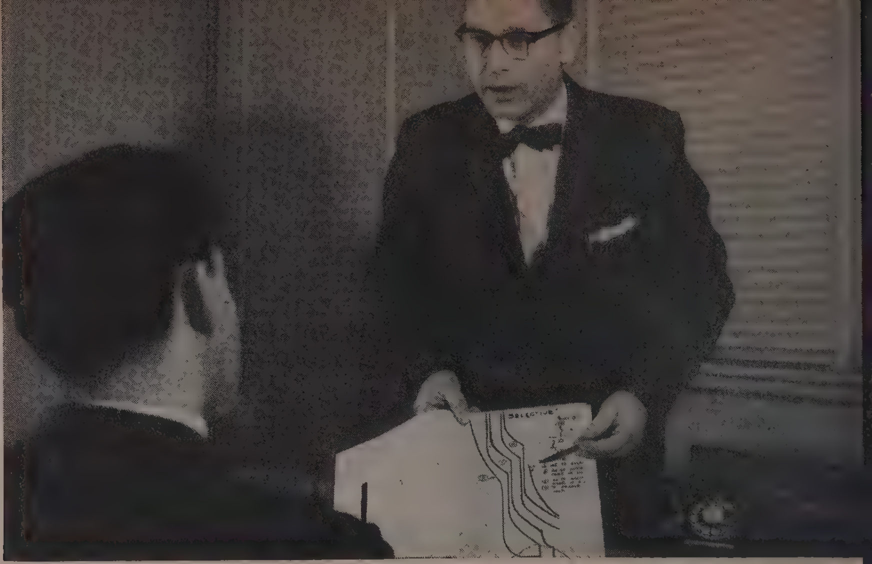
- Personal income in May set an all-time high annual rate of $399.4 billion. This was an increase of $1.6 billion from April; the April increase over March annual rate was $3.8 billion.
- Industrial output rose to 110% of (1957 average) in May, up from 109% in April and 109% in May of last year. Record high was 111% in January of 1960.
- Total employment rose to 67.2 million in May, up one million from April and nearly 1.2 million higher than in May of last year.
- Unemployment dropped to 3.5 million in May, down 200,000 from the month before, which is about normal for this time of year.
- Living costs in April edged up to a record 126.2% (of the 1947-49 average), or .5 higher than in March.

**New construction outlays during May held steady** at a seasonally adjusted annual rate of $53.9 billion, same as in April. Actual value of construction in May was an unadjusted $4.5 billion, up 10% from April, and 5% below construction expenditures in May of last year. Actual construction spending for the first five months of 1960 totaled $19.6 billion, or 2% behind last year.

Private construction spending reached a new peak for the first five months of this year, 1% above the similar 1959 period, while public construction for the five-month period was down 11% from 1959.

Nonfarm housing starts for the first four months of this year have fallen 21.5% behind starts for the same period last year, according to new Census Bureau estimates which tag starts at 377,300 for the January-April period in 1960, and at 480,900 in the same 1959 period. Starts in April this year were 110,400 compared with 142,200 units in April last year.

**Lease contracts for the construction of new post offices** are now being handed out by the Post Office Department at a rate of about six per working day. For fiscal year ended June 30, about 1400 post offices had been contracted for under the "commercial leasing program" begun in 1958.



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During any magnitude of feeder short circuit, the main breaker "waits" until the feeder breaker opens.

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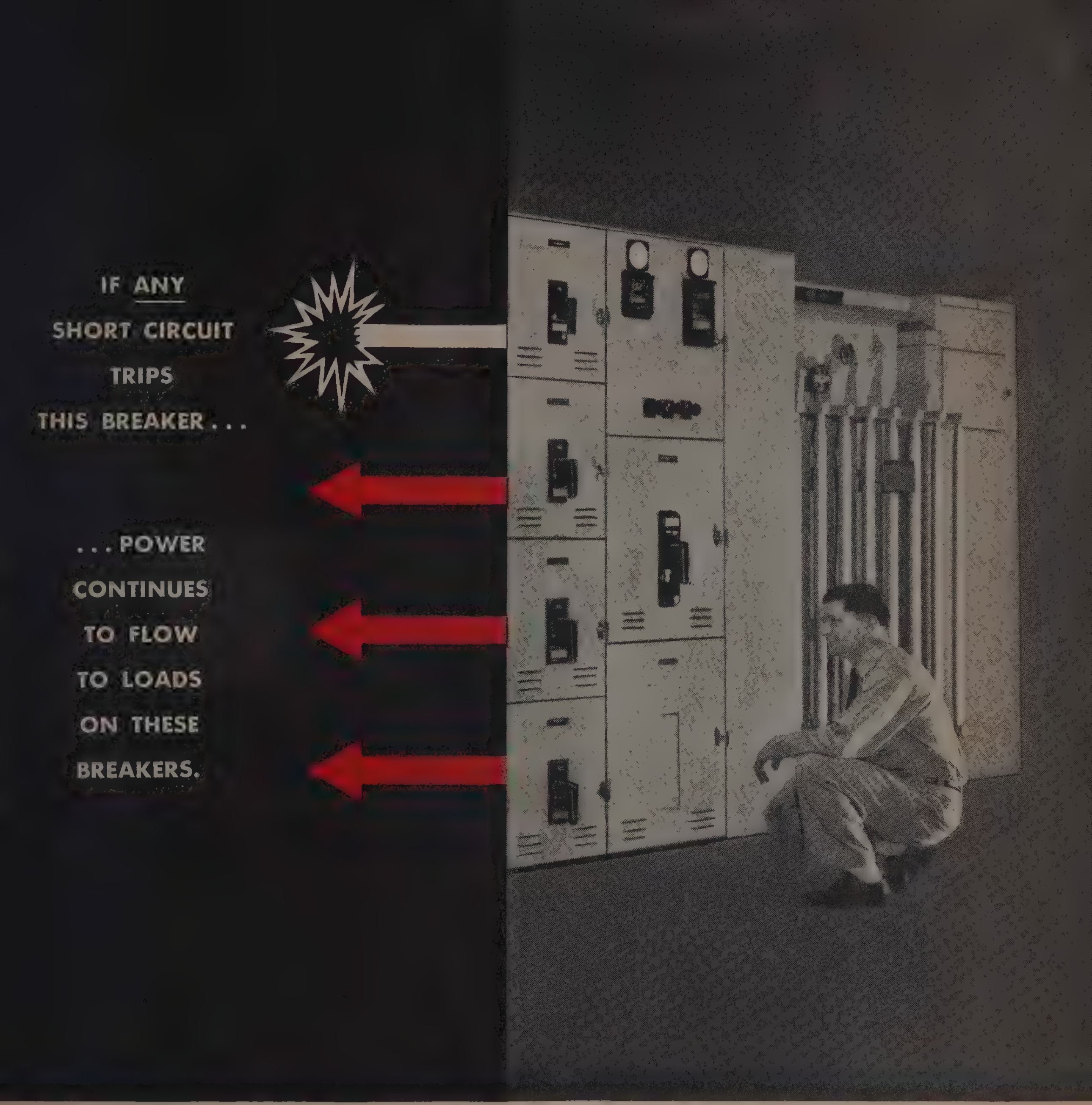
You now can have this superior coordination at no extra cost. Advanced engineering techniques by General Electric have eliminated the price premium normally charged for this inherently higher cost, more highly-engineered unit substation. In addition, you can save by using manually operated, stored-energy breakers in place of electrical units which were formerly required.


IF ANY SHORT CIRCUIT TRIPS THIS BREAKER . . .
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***ONLY CURVES PROVE YOU HAVE SELECTIVE COORDINATION***

Specify the SELECTIVELY COORDINATED Load-Center Unit Substation, with coordination curves for the specific breakers in your Load Center. These curves will show you how time-current characteristics combine to assure you of maximum power service continuity.

For more detailed information, contact your nearest General Electric Apparatus Sales Office, or write to General Electric Co., Schenectady 5, New York for publication GEA-3592.

531-02

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

# ENJAY BUTYL

## IS TOPS IN ALL-'ROUND

### RESISTANCE TO TEAR AND ABRASION

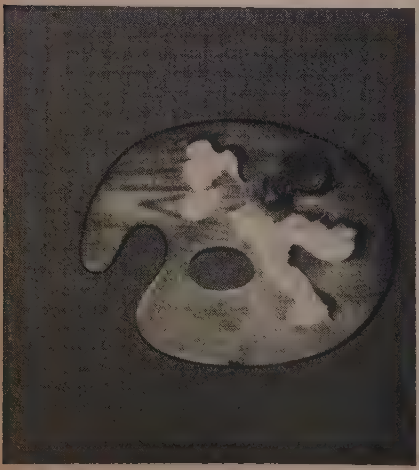
Enjay Butyl offers the highest aged tear strength of any rubber . . . even after long exposure to ozone and heat! Its inherent toughness resists abrasive wear, in such applications as tires, conveyer belts, hose and other mechanical goods.

### RESISTANCE TO SUNLIGHT AND WEATHERING

Enjay Butyl has proven its resistance to ultra-violet light, ozone, oxidation, moisture and mildew. Increases life of products such as weatherstrips, garden hose, wading pools and automotive parts.

### RESISTANCE TO CHEMICALS

Enjay Butyl, because of its unique and extremely low degree of unsaturation, offers excellent resistance to corrosive chemicals. The preferred rubber for tank linings, hose, seals, gaskets and other applications where exacting chemical resistance is required.



### VIVID COLORS

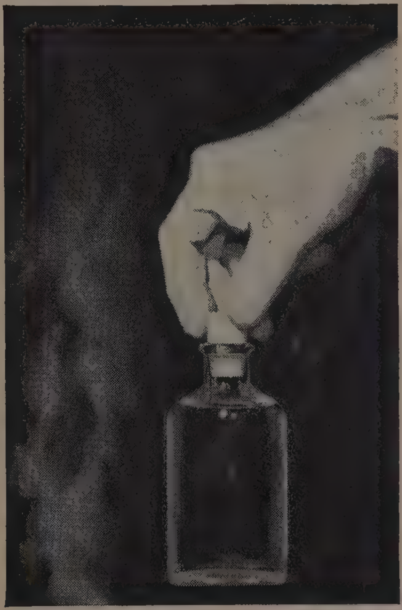
Enjay Butyl requires no additives for quality coloring over a wide range of hues. Famous for colorability and smooth finishes, Butyl has been successfully plastic coated for special applications.

# RUBBER

# *PERFORMANCE*

## DAMPING PROPERTIES

Enjay Butyl absorbs shock and vibrational energy more completely than any other rubber. Resiliency can be varied in compounding and processing. Butyl is ideal for axle and body bumpers, motor mounts and sound-deadening applications.



## IMPERMEABILITY TO GASES AND MOISTURE

Enjay Butyl is tops in impermeability to gases and moisture . . . retains air pressure 8 times better than natural rubber. Outperforms other rubbers in such application as inner tubes, jar and bottle seals, hoses and inflatable goods.

## ELECTRICAL RESISTANCE

Enjay Butyl tops all vulcanizable rubbers in electrical and dielectric properties . . . in resistance to corona and ozone breakdown and water absorption. Its high dielectric strength insures against electric breakdown under normal or surge voltage. Its heat resistance permits higher current flow for a given conductor size.

The outstanding properties of Butyl Rubber create new horizons for the designer, and offer to manufacturers an opportunity to utilize the qualities of rubber in applications never before possible. The unique properties of Butyl have led to vast improvement in many existing products. Technical skills will open the way to countless new uses.

Butyl is the "idea" rubber with uses stretching as far as the imagination can reach. We'll be glad to tell you all about it. Just contact the nearest Enjay office.

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

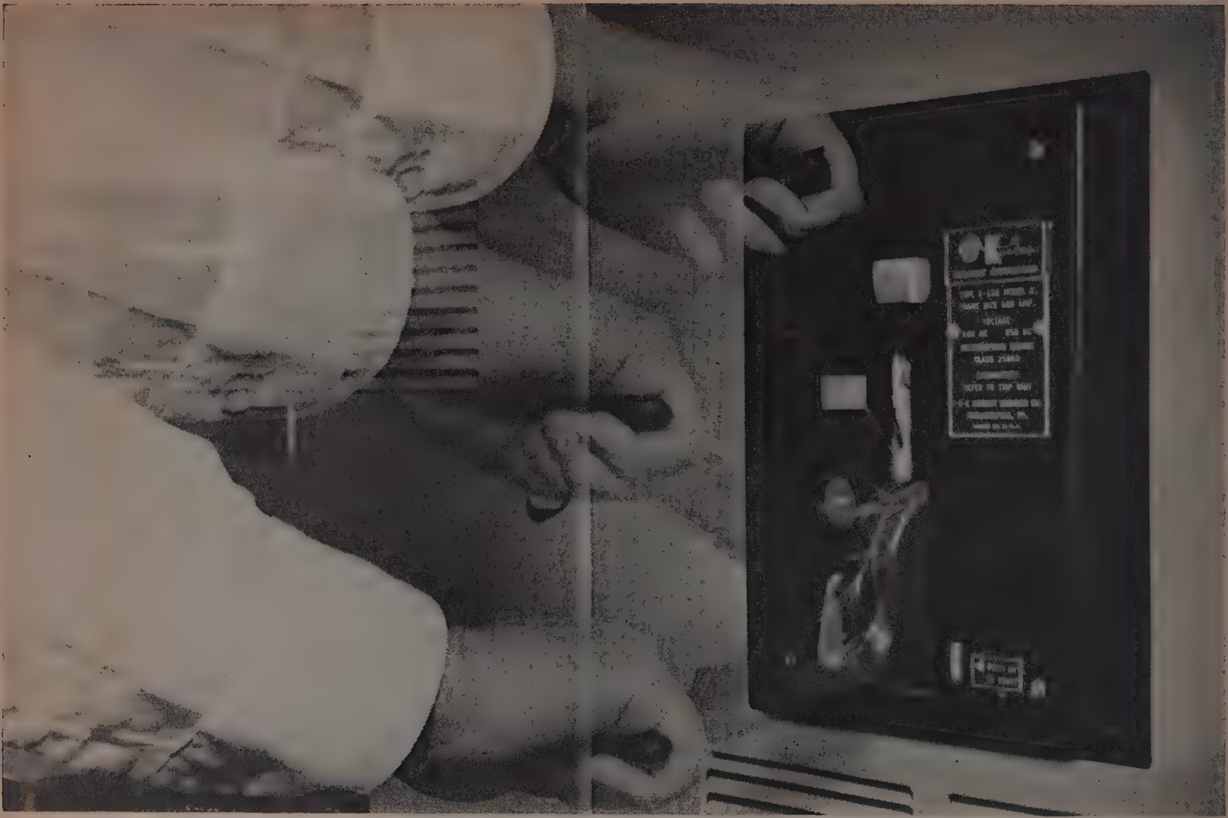
**ENJAY CHEMICAL COMPANY**

A DIVISION OF HUMBLE OIL & REFINING COMPANY

---

HOME OFFICE: 15 West 51st Street, New York 19, N. Y. OTHER OFFICES: Akron • Boston • Charlotte • Chicago • Detroit • Houston • Los Angeles • New Orleans • Tulsa

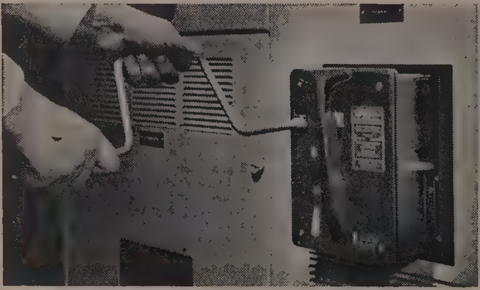
ENJAY
BUTYL



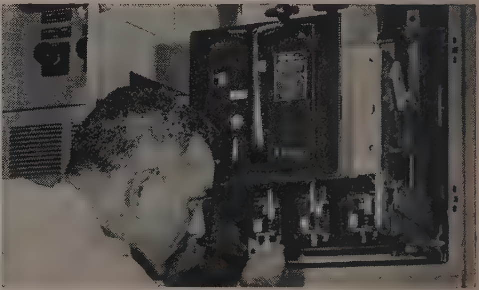
I-T-E started a revolution in 1957 when it introduced the completely new K-Line circuit breaker with stored energy closing. Today it is still the most advanced circuit breaker for low voltage switchgear you can buy.

# ONLY I-T-E 600 V. SWITCHGEAR GOES BEYOND STORED ENERGY

## GIVES YOU ADVANCES NO OTHER GEAR OFFERS



**Closed door disconnect.** A real safety feature. Operator can rack breaker out to either test or disconnect position without opening door. Prevents cluttered aisles from open doors and protruding breakers. And keeps breakers clean when they are disconnected.



**Expanded range trip.** I-T-E breakers can grow with your loads. Each trip device has roughly three to four times the range of conventional devices. Saves cost and downtime that replacement would demand. Easy to adjust. Calibrated directly in amperes.

**You pay no more.** That's right. With all these extra advances I-T-E low voltage switchgear costs no more. Send for detailed descriptive Bulletin 6004-C. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E

**I-T-E CIRCUIT BREAKER COMPANY**

**SILICONE NEWS from Dow Corning**

# Cable That Won't Quit

## SILASTIC® survives torture . . . keeps production going

These photos, and the story behind them, provide an idea of the extraordinary service you can expect from cable insulated with Silastic, the Dow Corning silicone rubber.

The place: Lukens Steel Company. The installation: Exposed feeder cable for a 200 hp motor that powers America's largest plate rolling mill.

The mill operates around the clock, seven days a week . . . meaning the cable insulation is continuously subjected to some of the worst conditions imaginable: heat from the red-hot steel only a few feet away; hot "scale" off the steel; dripping grease; the salt used for cleaning the mill bed; and plenty of moisture.

No wonder it was necessary to shut down this mill at least once a year to service the cable . . . that is, until 1955 when a feeder cable insulated with Silastic was installed. Since then, there hasn't been a moment's downtime (or any lost production) due to cable service . . . for there just hasn't been any cable failure!

Could performance like this help whittle *your* annual maintenance bill . . . and keep production in high gear? What are your requirements for an insulation that increases cable life in almost any application and performs reliably despite such rough operating environments as in this installation? Leading manufacturers now offer power cable, control cable, hookup wire, fixture wire and building wire with insulation of Silastic. The latter two, of course, meet accepted UL standards. Want a list of these suppliers? Just write Dept. 2807.

Cable size: 500 MCM. Operates at 250 volts.

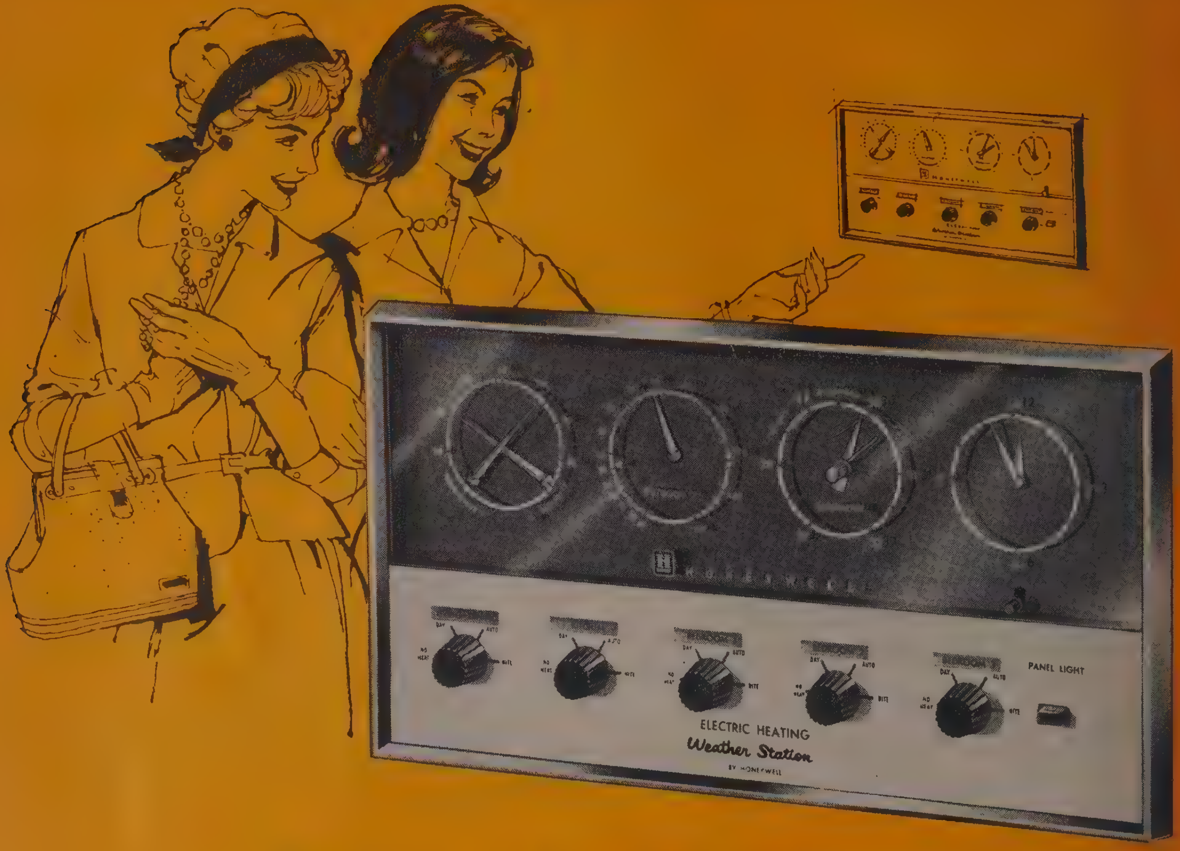
If you consider *all* the properties of a silicone rubber, you'll *specify Silastic.*

first in silicones

**Dow Corning CORPORATION**
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

FROM HONEYWELL... A DIAMOND JUBILEE PARADE OF PRODUCTS



# Honeywell's latest styles make

**The Honeywell Weather Station**—Here's a new symbol of the very finest in home comfort for the electrically heated home. Now, for the first time, your customers can control indoor comfort and check outside weather conditions at a single central location. Here, at last, is a complete precision instrument, so handsome and dramatic that your customers will want it mounted where everyone can see it!

Designed specifically for use with Honeywell's new low-voltage system, this unique new panel permits homemakers to pre-set day and nighttime temperatures whenever they please. They can check indoor humidity and *both* indoor and outdoor temperatures at a glance. The barometer forewarns of weather changes. Even an electric clock is provided to regulate the fully automatic day-nite temperature control schedule.

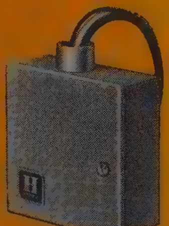
The lower portion of this unusual panel contains remote manual temperature settings for up to ten room thermostats. And, with the automatic night setback feature, homeowners are always assured healthful, more economical room temperatures during the night. New 7⅝″ x 13″ panel can be conveniently mounted on any wall in the kitchen, hall or den.

Truly, here *is* the finest comfort-control system you can offer your customers. You'll also find that the T-86E Honeywell Round is specifically designed to provide the very finest low-voltage temperature control for use with the Weather Station Panel.

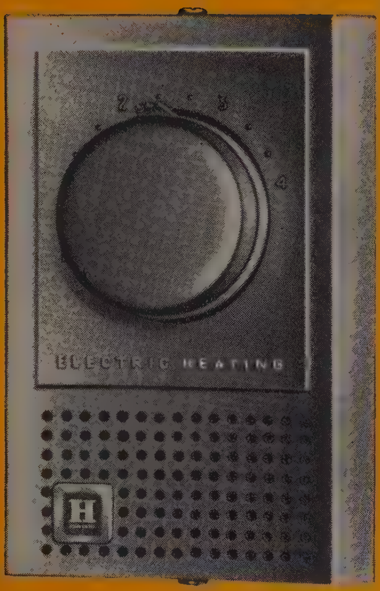
**New Control Center**—This attractive budget-minded Control Center permits manual control of night temperature setback for any or all of the thermostats in the system. Control Center is designed with four rotary switches—each capable of adjusting one or two zone thermostats. Models are also available with three or five switches. Control Center is gray with satin-finish aluminum trim, and measures 4 11/16 x 10 11/32 inches.

New T-86D Honeywell Round

T-460 Line-Voltage Thermostat



R-8097 Silent Relay



New T-462 Line-Voltage Thermostat

# Electric Heating most attractive!

**Two-Piece, Low-Voltage Control System**—After three years of extensive research and field testing, Honeywell presents the most advanced low-voltage control system ever available to the electric heating industry!

This new control system is the latest and finest among those specifically designed for electric heating alone. The highly responsive (20 to 50 cycles per hour) 24-volt T-86D provides unprecedented levels of comfort. Quiet, compact and inexpensive, the R-8097 Silent Relay teams up with the T-86D to attain the ultimate in sensitive low-voltage control.

The T-86E, with the night-setback feature, is used with the Electric Heating Weather Station or the Control Center.

**Line-Voltage Thermostats** offer the very finest for your economy-minded customers. The new *T-462 Line-Voltage Thermostat*, for example, features years-ahead styling—*plus* dependable performance. Specially developed for electric heating, the new T-462 uses the same dependable switching mechanism of the familiar T-460 thermostat. Offers everything you could ask for in a quality-built line-voltage thermostat: modern beauty *plus* compactness—high load capacity and responsiveness.

*The extra slim T-460 Line-Voltage Thermostat* is both attractive and compact. Cover can be removed and painted to match wall.

Not shown is the *T-40A Line-Voltage Thermostat* available in low temperature scale ranges for industrial applications.

For complete specifications on Honeywell's full line of electric heating controls, call your local Honeywell office. Or, write: Minneapolis-Honeywell, Dept. EC-7-121, Minneapolis 8, Minnesota.

**Honeywell**

H
HONEYWELL

First in Control

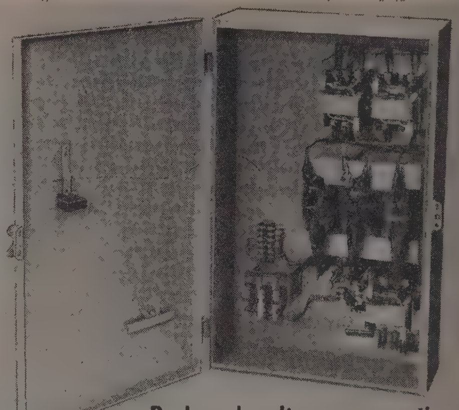
SINCE 1885

Two selling opportunities for contractors:

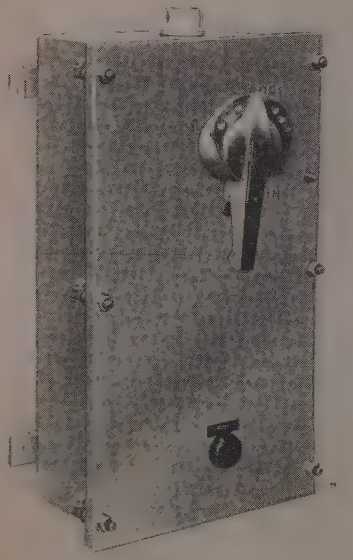
# You can give customers extra values and cut your service costs at no increase in the bid price

**Many General Electric control devices provide *extra value* with no price premium. Two of these devices offer particularly valuable selling opportunities:**

**OPPORTUNITY 1:** General Electric offers closed-circuit transition starting on all size 2 through 5 autotransformer-type automatic reduced-voltage controllers *as a standard feature.* (In this starting method, the motor is not disconnected from the line during the transition from reduced to full voltage; the transition is smooth because the current is not interrupted.) Take this opportunity to offer an extra operating advantage at no increase in your bid price. It can be an especially effective selling point in negotiated contracts with old, long-established customers.



Reduced voltage magnetic controller, Size 2



Stainless steel enclosure for combination starters

**OPPORTUNITY 2:** General Electric combination starters in stainless steel enclosures give users watertight, corrosion-resistant protection *at the same price as standard NEMA TYPE IV enclosures.* So, you can offer customers reduced maintenance (they won't have to repaint the enclosure) and reliable operation (contaminants cannot creep into the enclosure). Look for business in the meat packing, food, dairy, chemical, and other process industries. In bidding on a contract including these starters, you can sell a lower maintenance cost. In a maintenance contract covering these products, you can cut nuisance calls and the maintenance you must perform.

Such extra value features in General Electric control devices are *selling advantages* you can employ to help win contracts now—or to help you or your customers reduce maintenance in the future. For more information, contact your General Electric Apparatus Distributor or Sales Office. For specific information on reduced voltage starting, write for bulletin GEA-6860. General Electric Company, Schenectady 5, N. Y.

812-05

you get **MEASURABLE ADVANTAGES**
**WITH GENERAL ELECTRIC CONTROL**

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

## WORLD'S MOST WIDELY USED ELECTRICAL TEST INSTRUMENTS

# AMPROBE®

## THE ONLY LINE THAT COVERS ALL YOUR TESTING NEEDS

**The original pocket size snap-around volt-ammeter-ohmmeter**

### AMPROBE RS-3

5 current ranges. 3 voltage ranges. Ohmmeter specially designed for the maintenance field. Rotary scale for faster reading and greater accuracy. Pointer-Lock "freezes" pointer at reading. Advanced printed circuitry laughs at rough handling. Advanced movement design—new internal core magnet with self shielding characteristics. **By itself, the Amprobe RS-3 handles 99% of your test needs. With the Amprobe Deca-Tran and Amprobe Energizer it covers EVERY testing situation.**

*Only* **$52.50**

### AMPROBE RS-1

The economy snap-around volt ammeter with many features of the great RS-3 including rotary scale, pointer lock, printed circuit, and advanced movement design. 4 current ranges. 2 voltage ranges.

*Only* **$39.85**

### AMPROBE JR.

The advanced voltage tester that gives you current, too. Available in seven models, ranging from 10 amps to 100 amps in either 125/250 or 150/600 volts. Choose the model that fits your job.

*Only* **$19.85**

### AMPROBE DECA-TRAN

Makes your Amprobe the world's most flexible and versatile electrical test instrument. Extends amperage reading 10 times. Gets readings as high as 1200 amps.

*Only* **$24.75**

### AMPROBE ENERGIZER

Multiplies the sensitivity of any Amprobe ten times—for precise readings on small appliances and fractional horsepower motors.

*Only* **$3.75**

**PYRAMID INSTRUMENT CORPORATION,** LYNBROOK, N. Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND VOLT-AMMETERS.

ALCOA
ALUMINUM
Underwriters
RIGID C
ISSUE

# Hasn't sparked yet!

## Another good reason why Alcoa aluminum electrical rigid conduit is gaining in popularity

You don't need special nonsparking tools with aluminum. It's nonsparking for safer installations.

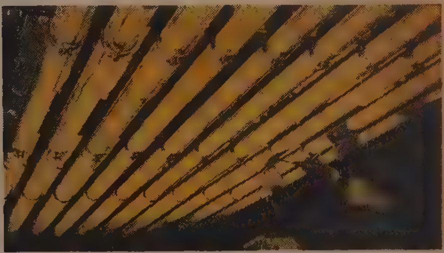
And, because Alcoa aluminum conduit *weighs less,* you can put it up faster. From warehouse to installation site you have only ⅓ as much weight to lift, load, carry and erect.

Cutting is fast—with hacksaw (or power tools on the larger sizes). Smaller sizes can be bent quickly, easily with an EMT bender. Use regular conduit dies (sharp ones, please!) and regular cutting oils for threading.

Wirepulling is easy too, since Alcoa aluminum conduit has a smooth, specially lubricated interior.

Competitively priced, aluminum conduit, also *offers corrosion-resistance, long life, good appearance.* Why not get all the facts and figures from your electrical distributor or one of our representatives.

Free literature on request. Just drop a line to Rome Cable Division of Alcoa, Dept. 7-70, Rome, New York.



**Goes up faster** Lightweight Alcoa conduit makes handling easier and faster—from warehouse to installation.

**ROME CABLE**
DIVISION OF **ALCOA**

# Anyone can Claim to Meet the RLM Standards for Uniform Quality

# BUT

**unbiased proof of conformance can only be had through repetitive tests by an independent laboratory such as is guaranteed by manufacturers offering RLM-LABELED LIGHTING EQUIPMENT**

When a buyer takes delivery on incandescent, fluorescent or mercury lighting equipment he has a right to expect that every fixture will meet his specifications in all respects.

With RLM-Labeled equipment uniform quality is guaranteed by the manufacturer . . . as well as by the RLM testing and certification program. This program is conducted by the world-famous independent testing organization, The Electrical Testing Laboratories of New York and hence represents the most modern testing program in the lighting industry. Under this program it is not enough that certain samples meet RLM Standards. *Every fixture* to which the manufacturer affixes a RLM Label is warranted by the manufacturer to meet applicable RLM Specifications.

Here you have one reason why there can be no such thing as a "RLM type" fixture . . . Either *it is RLM* with its testing and certification programs to guarantee uniform quality and high standards . . . *or it is NOT RLM!*

THE FINAL INGREDIENT OF BEING SURE

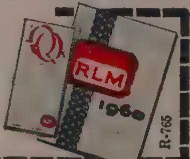
ETL Sphere Test used to determine overall efficiency of RLM incandescent lighting units.

*These TWIN QQ's to Industrial Lighting Success* are guaranteed with all lighting equipment bearing the RLM Label. Again there are new and upward Revised Standards for 1960. Mail coupon today.

**RLM STANDARDS INSTITUTE, Inc., Suite 8197, 326 W. Madison, Chicago 6, Ill.**

Please send free copy of the new "TWIN QQ" Pamphlet, the 1960 RLM SPECIFICATIONS BOOK and names of 22 leading manufacturers offering RLM-Labeled lighting equipment. (Please write name, company and address in margin below.)

Copyright 1960—RLM Standards Institute



**Naugatuck KRALASTIC®**

# Here's why large East Coast utility chooses **KRALASTIC** conduit

**Ease of use** Unlike the wood moldings and rigid type of conduit normally used, KRALASTIC conduit can be flexed to follow irregularities of pole or mounted equipment, saving many needless breaks or fittings. It is simply and quickly cut to length with a hacksaw, securely stapled in place. And conduit of KRALASTIC is easy to handle because it's lighter than aluminum.

**Protection** KRALASTIC is an excellent electrical insulator. It is extremely tough, even in thin-wall sections, in this case allowing reduction in conduit diameter from the previously used 2" to 1". It not only requires less material, but is less bulky and easier for linemen to climb around. KRALASTIC's unusual toughness protects against accidental damage from linemen as well as storms and other causes. And, of course, KRALASTIC can't rust, rot, or corrode, withstands weather at its worst.

**Economy** Because extruded KRALASTIC conduit is relatively inexpensive, unusually easy to work with, and extremely durable, it provides important savings in all areas.

What's *your* line? If it involves piping or conduit, it might well call for KRALASTIC... the original ABS plastic that has proved its superiorities in nearly 10,000 miles of piping installations, in other products from baby combs to football helmets. Better look into KRALASTIC *now*.

US RUBBER

**United States Rubber**
Naugatuck Chemical Division
734K ELM STREET
NAUGATUCK, CONNECTICUT

**KRALASTIC** RUBBER-RESINS • **MARVINOL** VINYLS • **VIBRIN** POLYESTERS

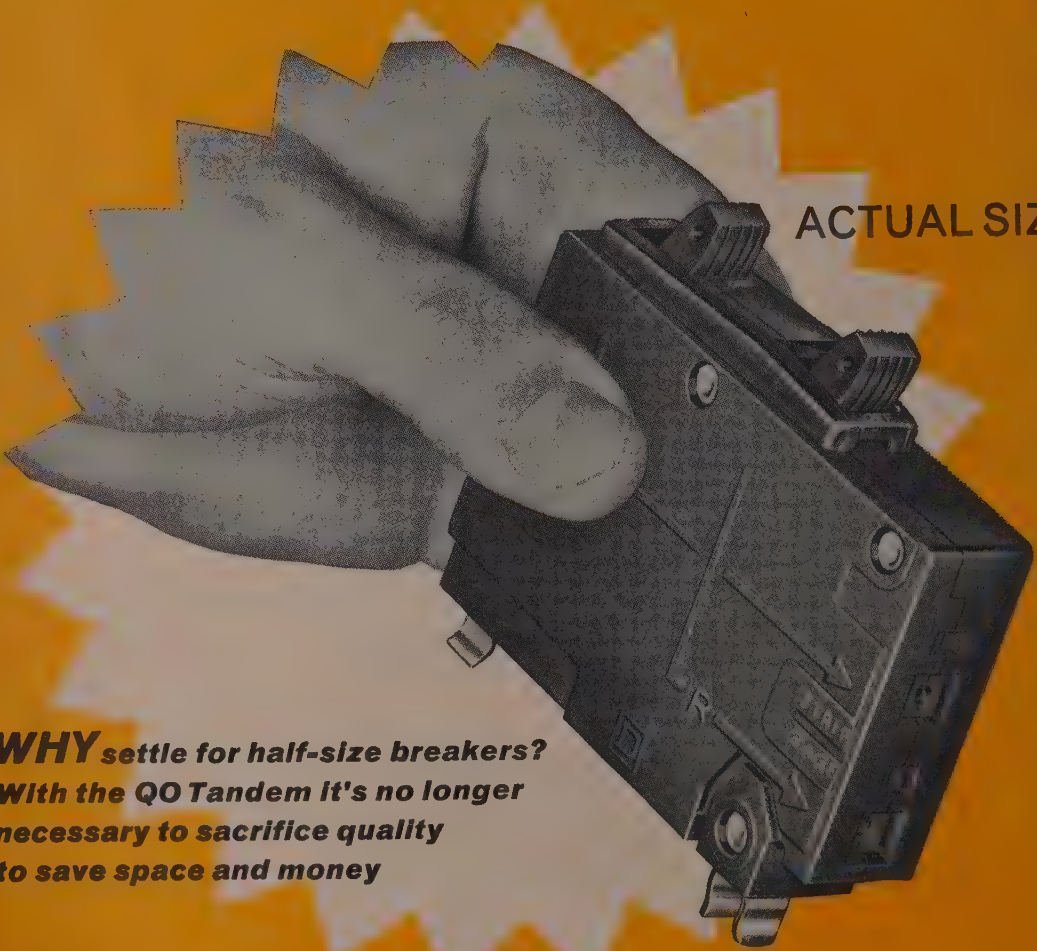
Akron · Boston · Chicago · Gastonia · Los Angeles · Memphis · New York · Phila. · CANADA: Naugatuck Chemicals · Elmira, Ont. · Cable: Rubexport, N.Y.

# HERE'S THE big NEWS

## *Square D's **New QO Tandem** Combines Two Full Size Breakers*

## ***IN ONE SPACE-SAVING UNIT!***

*BUT—Read On for The Pay-Off*



***WHY** settle for half-size breakers? With the QO Tandem it's no longer necessary to sacrifice quality to save space and money*

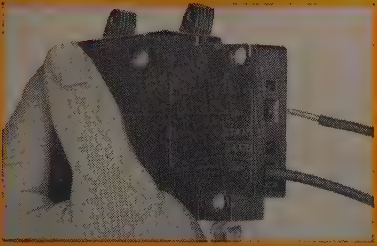
**SQUARE D COMPANY**

# IN CIRCUIT BREAKERS!

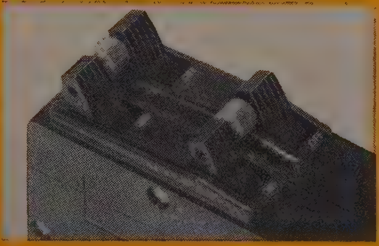
## Still Maintains ALL the QO features

## PLUS

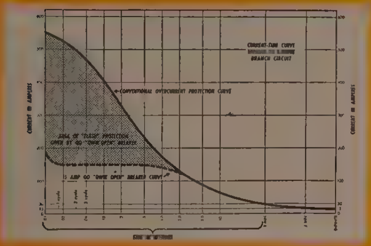
## these NEW ONES!



**NEW AND EXCLUSIVE *PUSH-IN* CONNECTORS**
Fast, positive connections. Holds on 5000 amp shorts.



***DOUBLE* DOUBLE POLES**
Doubles the number of 15 and 20 amp double-pole breakers. Uses QO handle tie.

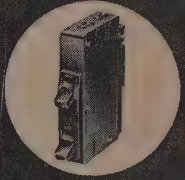


***QWIK-OPEN* THERMAL-MAGNETIC**
Magnetic opens on first flash. Thermal holds on overloads. No known protection is faster.

**SAVES SPACE AND MONEY**
More circuits in same space. Lower device cost. Save up to 20%.

*Write for latest **QO** Bulletin which tells the complete story of the finest breaker ever built. Address Square D Company, Mercer Road, Lexington, Kentucky.*

### THE QO FAMILY



the New
**QO TANDEM**
15-20 Amp

QO 1-POLE
15-50 Amp

QO 2-POLE
15-70 Amp

QO 3-POLE
15-50 Amp

QI 2-POLE
70-100 Amp

QI 3-POLE
70-100 Amp

*wherever electricity is distributed and controlled*

# "I'm convinced! Telephone-planning my homes helps me sell them faster"

*Your local Telephone Business Office will gladly help you telephone plan your homes. For details on home telephone installations, see Sweet's Light Construction File 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.*

**BELL TELEPHONE SYSTEM**

**SAYS LUKE FOGARTY**
**OF FOGARTY BUILDERS, JOLIET, ILL.**

"I believe in pre-wiring my homes for telephone convenience," says builder Fogarty. "It's a feature people want and *I'm convinced* it helps me sell my homes faster. I'm a practical man, too. I know it gives me a competitive advantage."

Mr. Fogarty, who builds homes in the $17,000-$35,000 range and has recently acquired land for 1250 more Telephone-Planned homes, provides from 10 to 12 pre-wired outlets in each home. In addition, he advertised his homes as "Certified Telephone Planned Homes."

"I give a gift certificate to every customer for an extension phone," he says. "He can choose his own color and the telephone company will install it where he wants it. I'm also providing a patio outdoor jack for all of the homes I build on half-acre lots.

"Folks today *expect* a modern home to provide for extension telephone service. And I certainly believe in giving them what they want."

* * *

Joliet builder Luke Fogarty (right) and telephone man Frank Metzger survey one of Fogarty's Brook Forest split level homes.

# Almost 50% saving "just around the bend"

# NEW Blackhawk 4" one-shot bender

Talk about spectacular savings — *you pocket more than $11 per bend over other methods.* This new Blackhawk bender pays for itself on just a couple of jobs. From then on it's gravy all the way.

This portable bender goes right to the job. You eliminate about half of the fittings, pipe threading and the time it takes to make connections.

Bends aluminum! You make exact 90° bends in steel or aluminum conduit in a single operation. A protractor-type "Optik-Angle" gage accurately measures the degree of bend in progress. And these benders are easy to handle due to lightweight, aluminum alloy construction, and lift-off frame top for quick pipe insertion.

**CATALOG / MANUAL L-400** has full details on Blackhawk's family of time-saving, money-saving pipe benders.
Write Dept. P-2070 today for your free copy.

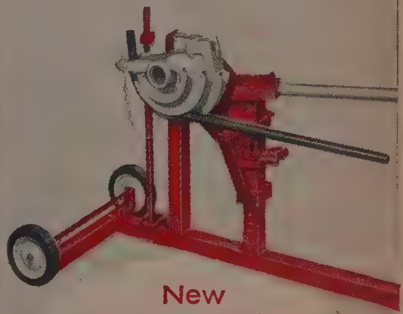
**BLACKHAWK®**

BLACKHAWK INDUSTRIAL DIVISION
13320 W. Reichert Pl., Butler, Wis.

## OTHER NEW PRODUCTS

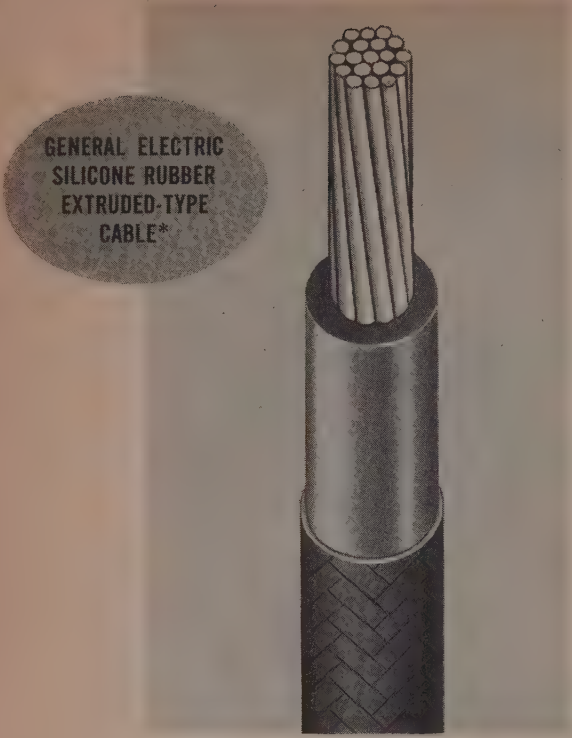
### Take the guesswork out of hand bending

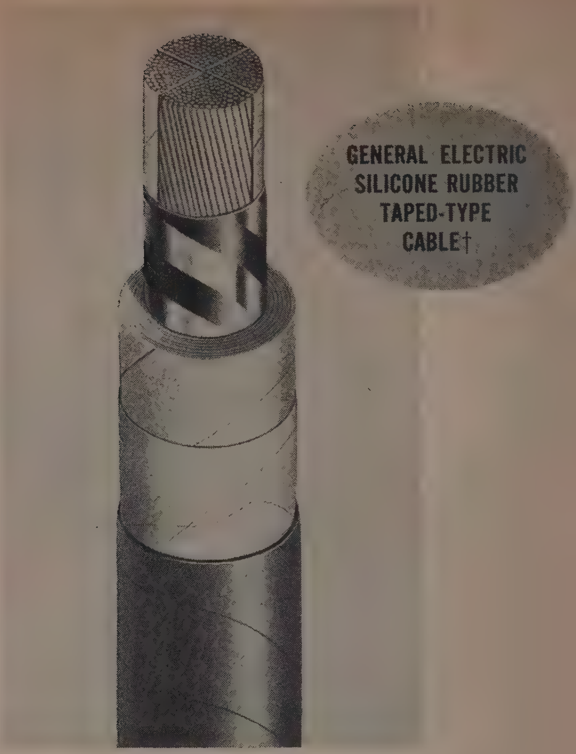
Here's Blackhawk's new rigid and thinwall hand bender that makes perfect 45° and 90° bends. As accurate as a carpenter's level, Blackhawk's Level Bender has unique double "bubbles" to do the figuring for you. You'll be amazed at the ease with which you make 90° bends, offset bends, saddle bends, back-to-back bends in ½", ¾" or 1" thinwall. Aluminum alloy construction is lightweight, yet built for hard work.



### New Ratchet Rig saves on "ells"

Foolproof ratchet action makes perfect "ells," eliminating the extra expense of manufactured ells. The rig is easy to operate — anyone can do it after a few minutes' instruction. Lock-on shoes are quickly interchangeable to bend rigid conduit or aluminum. An "Optik-Angle" gage assures bending accuracy. Ratchet Rig is either portable or can be mounted on a pickup truck.





# When Heat Is Your Problem Install G-E Silicone Rubber Cables

## Why silicone rubber cables?

BECAUSE

1. General Electric silicone rubber cables operate at a conductor temperature of 125 C in power and control applications and 200 C as appliance and fixture wire . . . conditions which would quickly embrittle ordinary rubber insulations.
2. G-E silicone rubber cables provide excellent moisture, corona, and ozone resistance and remain flexible at temperatures down to —55 C.
3. G-E silicone rubber cables are the answer to space bottlenecks such as size of existing ducts and conduits—the higher current-carrying capacity of these cables permits the use of smaller conductor sizes.

## Why General Electric silicone rubber cables?

BECAUSE

1. General Electric has the greatest experience in the development and manufacture of silicone rubber cables.
2. General Electric is the only wire and cable manufacturer that produces its own silicone rubber insulations from start to finish in its own plants.
3. General Electric has the most complete line of silicone rubber cables in the industry.

### * Outstanding Features of G-E Silicone Rubber Extruded-type Cables

- Insulation has improved physical properties—typical values of 1400 psi tensile strength; 380% elongation
- Increased tear strength
- Easily terminated and spliced
- No shielding required up to 5 kv
- Require no lead sheath in wet locations

### † Outstanding Features of G-E Silicone Rubber Taped-type Cables

- Excellent electrical properties—high dielectric strength, low power factor
- Available in large conductor sizes up to 3500 MCM —standard strand or compact segmental conductors
- New heat-sealed taped jackets available for moisture resistance at above-normal temperatures

These and many other General Electric wires and cables are offering customers many important benefits because—It's What's Over The Conductor That Counts.
Get details on all the advantages of G-E silicone rubber cables. Write: Section W-300, General Electric Company, Wire and Cable Department, Bridgeport 2, Connecticut.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

*For emergency stopping*... **NEW ASCO BREAK-GLASS SWITCH**

In a fire, the quick stopping of equipment such as oil burners and ventilators, can reduce the danger of the fire spreading or explosion. ASCO Break-Glass Switches provide a fast means of stopping equipment from any point throughout your plant.

When glass in switch is broken, switch contacts open and equipment stops. Contacts remain open until glass is replaced.

Designed for use with oil burners, ventilators, air conditioners, refrigeration and a variety of other equipment, ASCO switches feature heavy-duty contacts and solid brass construction for maximum reliability.

They are available single pole, single and double throw, for 2 or 3 wire control devices. Interrupting capacity: 5 amps. at 250V. A-C; 10 amps. at 125V. A-C. Switches come equipped with hammer and have emergency instructions clearly displayed on cover.
**For complete information write for Bulletin 124.**

**Important news for contractors and consulting engineers!**
Since June 1, 1959, New York City Department of Buildings has required that each ventilating installation be equipped "with a manual emergency stop located at a conveniently accessible point for quick shutting down of all fans in case of fire."

**ASCO Electromagnetic Control**
Automatic Switch Co. 50-J HANOVER RD., FLORHAM PARK, N. J., FRONTIER 7-4600
*AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL*

ASCO

**BEFORE "Operation UPlight"** Assembly Products, Inc., of Chesterland, Ohio, had to supplement their general ligh system with additional fixtures to provide sufficient illumination at work levels for their precision manufactu operations. This combination resulted in extreme brightness variations.

# Only 7/10¢ per hour*..

---

**"The combination of at least 300 footcandles along with the determination of the most practical mounting height (7′ 6″) made the selection of the lighting fixture at Assembly Products, Inc. an extremely critical consideration,"**

**says Consulting Engineer**
**Anton J. Eichmuller**
**Cleveland, Ohio**

"However, after seeing the results of the installation, we were firmly convinced that our choice of Day-Brite CFI-30 Power-Groove Industrials was right. The resulting low-brightness and high efficiency are evident to all; most importantly to the people working in the area because it eliminates eye fatigue.

"Of almost equal importance are the excellent design and construction features of CFI-30, which were attested to by the electrical contractor (Herbst Electric Co.) who installed the Day-Brite units. These features too will pay big dividends to the owner for years to come.

"The excellence of the results, plus the fine handling of the order by Day-Brite factory and local representatives, have given us another outstanding job, fully appreciated by Mr. Saint Amour (President, Assembly Products) and myself. This is an example of another Day-Brite installation well received and appreciated."

A. J. Eichmuller (right) and Day-Brite representative Tony Dunn examine the Day-Brite CFI-30.

**FTER "Operation UPlight"** Day-Brite CFI-30 fixtures, equipped with Power-Groove lamps, boosted illumination to 00 footcandles and balanced brightness with 22½% uplighting. Fixtures were mounted in continuous rows on -foot centers, 7½ feet above the floor. The ACTUAL difference is even greater than these photographs show.

# for 300 footcandles

## lore light for less money with Day-Brite CFI® fixtures!

nat's "Operation UPlight". The new Day-Brite FI (Comfort For Industry) fixtures are designed deliver the higher lighting intensities currently commended . . . yet substantially reduce installed, erating and total owning costs. And *now*, with ices reduced as much as 17.7%, Day-Brite CFI tures are within the range of *every* industrial light- g application.

r actual cost figures comparing Day-Brite CFI tures with other lighting systems, call your ay-Brite representative listed in the Yellow Pages. e for yourself why hundreds of companies across e country have put "Operation UPlight" into tion, making it the most successful program in ay-Brite history. PHONE TODAY!

*✱per footcandle for each 10,000 square feet. Based on 4,000-hour operation, 1¢ per KWH rate, 35% lamp discount, typical maintenance cost, and amortizing the cost of buying and installing the lighting units over a ten year period.*

DAY-BRITE

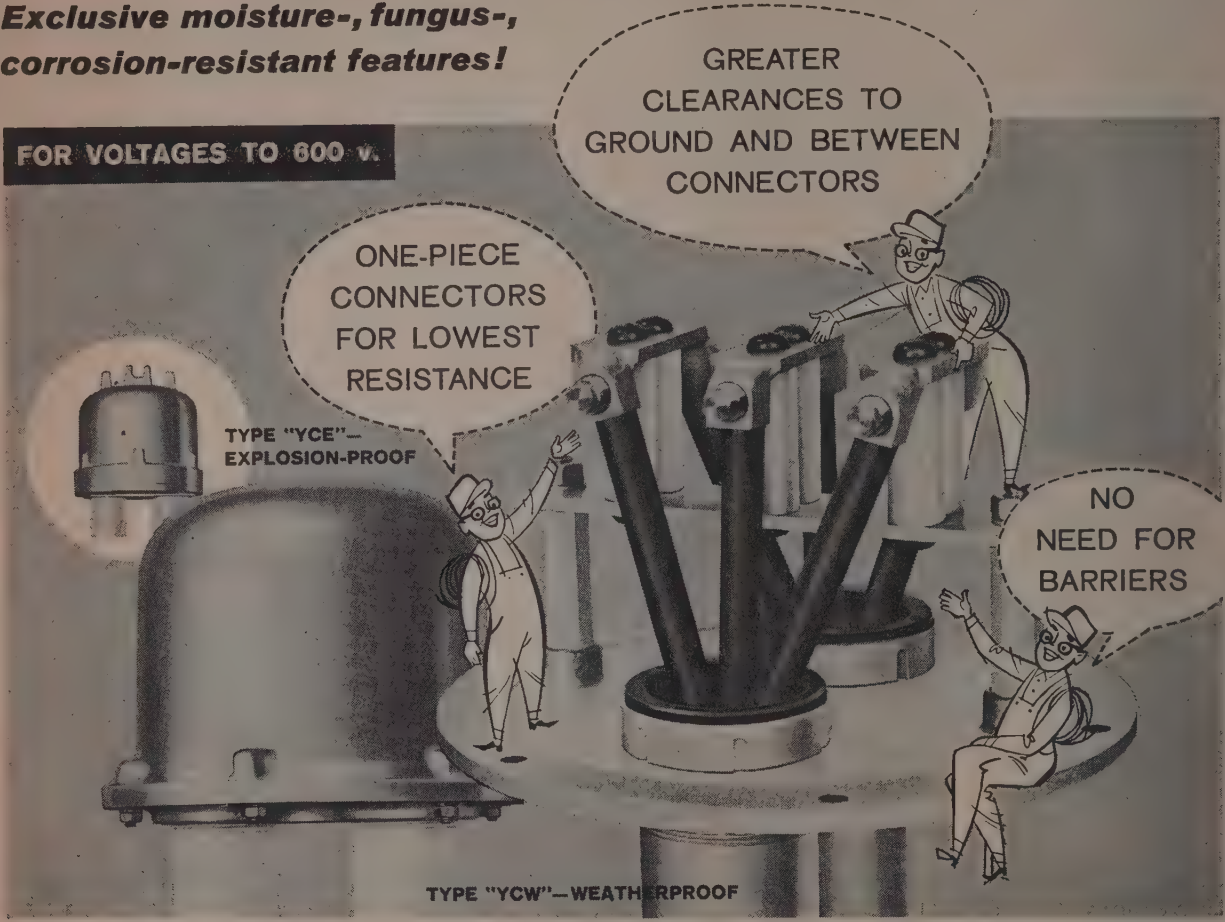
DAY-BRITE

*Day-Brite Lighting, Inc.*
*St. Louis, Mo. • Santa Clara, Calif.*

NATION'S LARGEST MANUFACTURER OF COMMERCIAL
AND INDUSTRIAL LIGHTING EQUIPMENT

# NEW! O.Z. PULL-N-SPLICE BOXES!
# CONVENIENT · COMPACT · ECONOMICAL

***Exclusive moisture-, fungus-, corrosion-resistant features!***


FOR VOLTAGES TO 600 v.
GREATER CLEARANCES TO GROUND AND BETWEEN CONNECTORS
ONE-PIECE CONNECTORS FOR LOWEST RESISTANCE
TYPE "YCE"— EXPLOSION-PROOF
NO NEED FOR BARRIERS
TYPE "YCW"—WEATHERPROOF

O.Z. Pull-n-Splice Boxes mark a significant advance in pull box construction!

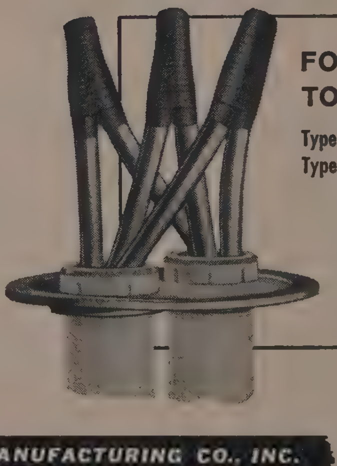
Their highly compact size saves *more space than ever!*

Their more efficient design means *new savings in installation time and labor!*

Their moisture-, fungus-, and corrosion-resistant features mean long, trouble-free service.

Still, with all their features, the new O.Z. Pull-n-Splice Boxes are *smaller* — and *cost far less* than conventional pull boxes . . . even late model *competitive* types! And, you get a bonus in high quality materials and workmanship so characteristic of *all* O.Z. products!

For complete information on these and the many other O.Z. products that mean more for you, call your local O.Z. distributor, or write to the company.



**FOR VOLTAGES TO 5000 v.**

Type "YPW" — Weatherproof
Type "YPE" — Explosion-proof

Deeper dome than "YCW" and "YCE". Furnished without connector panels. Insulated pigtail splices recommended.

**O.Z. ELECTRICAL MANUFACTURING CO., INC.**
262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GArfield 1-7846

IN ELECTRICAL WIRE & CABLE . . . **THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE**

KAISER WIRE

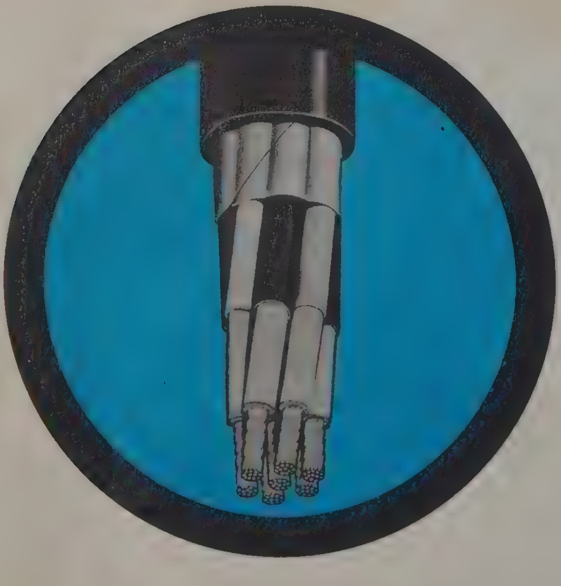
# CONTROL CABLE... 28 YEARS OF PERFECT INSULATION SERVICE

KAISER MASTER LAYTEX® CONTROL CABLE has never known a reported insulation failure!...and the introduction of patented Laytex-Resin promises to improve upon this 28-year record of perfection!

Laytex-Resin is the combination of Laytex insulation with a specially-compounded resin layer over the insulation that eliminates the bulk of braided coverings. It brings the following advantages over extruded constructions:

Smaller diameter, to expand service without enlarging ducts...less weight...increased flexibility...proven greater insulation protection against acids, alkalies, flame, fungus, water, oil, ozone and light...uniform protection free of thin spots...can't wick moisture or fray...easier splicing...brighter color coding and longer lengths per reel.

SPECIFY 935-S. ASK FOR KAISER CONTROL CABLE BOOKLET.



# POWER CABLE... 16.4 TIMES MORE OZONE RESISTANCE

KAISER GRIZZLY® POWER CABLE is the only power cable to resist 6000 hours of high ozone shock test—outlasting 9 leading brands tested!

Several samples of each unshielded 5KV cable were placed with a "U" bend resting on a grounded metal plate. A conductor-to-plate potential of 40,000 volts was applied until all cables failed. Four brands failed immediately. The last competitor gave out 432 hours before the first Kaiser cable. Kaiser Grizzly samples went on to last over 6000 hours . . . 16.4 times longer than the test average of best performances . . . 2.4 times the life of the nearest competitor.

The reason: A superior combination of Kaiser insulation and jacketing. In power cables it represents a major victory over the main cause of failure—dielectric breakdown due to ozone.

AVAILABLE IN A WIDE RANGE OF SIZES AND SPECIFICATIONS FOR OVERHEAD AND UNDERGROUND HIGH-VOLTAGE APPLICATIONS.

# K/W PORTABLE CORD... NEARLY THREE TIMES AS MUCH SERVICE

KAISER MASTER LAYTEX® PORTABLE CORD is tested and proven to give nearly three times the service, on the average, of cords of equal price. A saving of two-thirds in actual cord costs on the job!

This superiority came from Kaiser research into all causes of portable cord failure—more than 12,000 individual tests comparing more than 1000 cords of all makes.

The results: Patented K/W portable cord with a lead-cured 60% Neoprene jacket surpassing ASTM D-752 requirements from 15% to 100%...rayon fillers for overall resistance to pull...fibrous core inside the conductors to absorb strain, increase flexibility . . . conductors perfectly centered in grainless Kaiser Laytex insulation which has three times the strength of milled natural rubber.

SPECIFY NO. 920 FOR HEAVY DUTY (600 V.), NO. 921 FOR LIGHT DUTY (300 V.). ASK FOR KAISER MASTER LAYTEX® PORTABLE CORD BOOKLET.

# IN ELECTRICAL WIRE & CABLE THE SPARK OF QUALITY IS K/W EXPERIENCE

The spark of quality means positive—often dramatic—savings in service for those who will specify Kaiser wire and cable.

Among the world's leading electrical wire and cable producers, only Kaiser is heir to the 70-year experience of a major rubber company in developing insulation and jacketing compounds.

Insulations such as Laytex®, Laytex-Resin, Hydrosec® and Kalzone give greater utility, longer life to a complete range of aluminum or copper conductors. For immediate service in any type of wire or cable, call your K/W Distributor or Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center,
300 Lakeside Drive
Oakland 12,
California.

KAISER ALUMINUM

## Employee Gift Matching

# Another Good Way To Help Our Colleges And Universities

The business community continues to make an impressive record in giving badly needed financial help to our colleges and universities. This year the Council for Financial Aid to Education expects that business contributions to higher education will be well over four times their total of about $40 million a decade ago.

If these contributions, which were about $150 million last year, continue to increase at the present rate, they will hit the target of $500 million set for business aid to our colleges and universities in 1970. This is the amount which, the Council calculates, must come from business if these institutions are to have the money to do their job properly a decade hence.

However, it would be a fine thing both for the nation and the business community if that $500 million dollar target were hit well before 1970. This would put us ahead of a schedule (it is a conservative schedule) in getting on top of what remains one of the nation's most crucial problems—that of having its colleges and universities adequately financed which they are very far from being right now.

**There is, we believe, one quite simple way by which financial support for higher education by business firms might be considerably speeded up. All that is required is that business firms generally abandon the idea that it is possible for every company to have a program to provide such support that is novel and distinctive, and** that this is the only way that interests of prestige and good public relations can be served.

There are nowhere near enough good plans to provide financial help for higher education to equip even a small percentage of our business firms with one that is novel and distinctive. Also **there are a number of very good plans which, so far as we can tell, lose nothing of their value for prestige and good public relations by being used by a large number of companies.**

### The Gift Matching Idea

One plan with these attractive characteristics is the plan by which companies match the gifts of their employees to colleges and universities, and now increasingly gifts to independent secondary schools. So far as we can discover the general plan was invented by the General Electric Company, with what it calls its Corporate Alumnus Program. Now, with variations on the same basic design, almost 100 companies have gift matching plans. We at McGraw-Hill are included in this number.

The gift matching plans vary considerably in detail. Some are limited to alumni of the schools to be benefited. In others any employee can participate by making a gift to an eligible institution. There are also variations in the maximum amounts of gifts by individuals and to individual institutions which will be matched. Some companies have "open end" plans; others limit the total to be matched in any one year. All of the plans, however, embody the same central gift matching idea.

When the plan was first launched some college administrators of little faith in the fundamental generosity of the alumni and friends of their schools expressed the fear that if gifts were to be matched they might be made smaller in the first place. The opposing view was that the possibility of having them matched would stimulate more and larger gifts.

### Advantages Of Gift Matching

**So far as we have been able to discover, the expectation that giving would be stimulated by gift matching has been validated by the experience with the plans.** This has been our experience at McGraw-Hill. Some other important virtues of the gift matching programs have been summarized by

### LEADERS OF SOME OF THE INSTITUTIONS WHICH HAVE SHARED IN THE McGRAW-HILL EMPLOYEE GIFT MATCHING PROGRAM EXPRESS THEIR VIEWS

*"We particularly appreciate the fact that your grant is unrestricted, and can therefore be used for our area of greatest continuing need — the General Education Fund, from which faculty salaries come."*

W. BOYD ALEXANDER, Vice President and
Dean of the Faculty
**Antioch College**

*"We are grateful, not only for the financial support given to The Cooper Union by your company, but also for the stimulus it has provided our alumni in your employ to make annual gifts to their Alma Mater."*

EDWIN S. BURDELL, President
**The Cooper Union**

*"The gift matching program has a dual advantage. First, it acknowledges and repays a debt of honor to those colleges which, often at great loss to themselves, have trained and educated the men who are now among your personnel. This is most fair and equitable. Secondly, by offering to match up to a given limit the contributions of alumni, you encourage support of their own colleges on the part of graduates, who themselves are so indebted."*

President EDWARD B. BUNN, S. J.
**Georgetown University**

*"Thanks to your doubling of the annual gifts of one of our generous and loyal friends who works with you at McGraw-Hill, we are well on the way toward creating what for us will be an extremely helpful scholarship fund. This would not have been possible without the gift matching program."*

C. ADRIAN HEATON, President
**California Baptist Theological Seminary**

Ernest T. Stewart, Executive Director of the American Alumni Council (1785 Massachusetts Avenue, N.W., Washington, D.C.) who would be glad to provide detailed information about them, and the names of companies having such plans. Of the gift matching idea he says,

> "*First*—it assures the corporation that its gifts go direct to those colleges and universities which have furnished it with trained manpower.
>
> "*Second*—it places responsibilities for the gifts on the institutions themselves and drives home the point that they must make a real effort with their own alumni.
>
> "*Third*—it leaves the final decision of corporate support basically to the employees."

For many companies which are fearful of complicating their relations with their customers by courting charges of favoritism if they provide direct financial support for any particular school or group of schools, this latter consideration can be of decisive importance.

The gift matching plan also has what for many companies is the very important virtue of being simply and easily administered. Some additional virtues of the gift matching plan, as seen by officers of institutions which have been beneficiaries, are indicated in the box at the top of this page.

## Effective And Easily Managed

We at McGraw-Hill are well pleased with our gift matching program. It is a broad program in which all employees and a wide array of colleges and universities, both privately and publicly supported, are eligible to participate. We commend it as an effective and easily managed plan to provide urgently needed financial aid to higher education.

**We also urge that business firms adopt this or one of a number of other very good programs of financial aid to higher education* rather than delay in the hope of hitting upon some quite new and distinctive plan. There are very long odds that such delay will prove unavailing. In the meantime our colleges will be losing financial help which it is profoundly in the interest of the business community and the nation to see that they get—and get fast.**

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.*

Donald C McGraw
PRESIDENT
**McGRAW-HILL PUBLISHING COMPANY, INC.**

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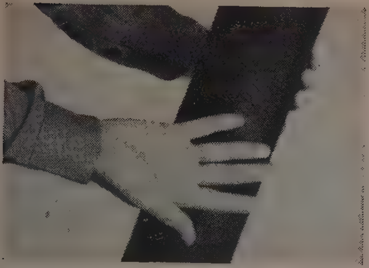
*An earlier editorial in this series dealt with tuition supplements as another good way to help our colleges and universities. Reprints of this editorial are available. So are copies of a "more or less socratic dialog," entitled, **A Business Wrestling with the Problem of Aid to Colleges and Universities.** It was prompted by the efforts of McGraw-Hill to find suitable methods of providing financial aid to higher education.

*Orangeburg klean-kote conduit available with fl*
*CA (Coupling Attached) at no additional cost.*
*(Fork Lift) units of Orangeburg Conduit in tr*
*load shipments save you time, space and handl*

✲ KLEAN-KOTE IS A TRADE-MARK; U. S. PATENT APPLIED FOR. ORANGEBURG KLEAN-KOTE DISTRIBUTED BY GRAYBAR ELECTRIC CO. AND GENERAL ELECTRIC SUPPLY CO. WITH BRANCHES AND STORES IN PRINCIPAL CITIES.

Cleaner Hands



Handle a length and you'll see little or no black rubs off. New *klean-kote* Orangeburg Conduit is much cleaner than ordinary *un*-coated conduit.

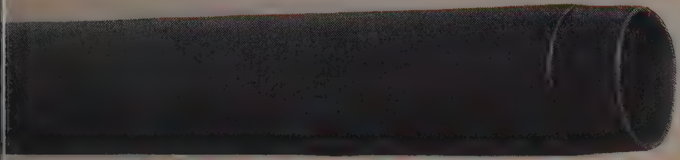
Cleaner Clothes

Completely sealed with durable coating, new *klean-kote* Orangeburg Conduit won't "smudge" on clothing. Cleaner to handle, store and install.

No Irritation

There's virtually no dust or soot to cause annoying irritation to face, hands or arms. New *klean-kote* conduit is another exclusive with Orangeburg.

klean-kote*



**ORANGEBURG®**

**Fibre Conduit**

A development of Orangeburg and Flintkote Research Laboratories, new *klean-kote* Orangeburg Fibre Conduit has a tough, non-brittle, protective coating for cleaner, safer handling.

To you and your men, this literally means cleaner hands, cleaner clothes and little or no chance of hand or face irritation. In addition, new *klean-kote* travels better. Weathers better. Joins better.

Best of all, nothing has been changed in the traditional fine quality of the Orangeburg product. New *klean-kote* is just what the name implies —*a clean coating*. Beneath this protective coating lies the same quality product, manufactured with the same painstaking care which has made Orangeburg the best-known, best-selling line in America.

Ask your Orangeburg Wholesaler to show you a length of new *klean-kote* and place your order now.

*Orangeburg Manufacturing Co., Orangeburg, N.Y. • Division of The Flintkote Company*

FLINTKOTE

*Manufacturer of America's Broadest Line of Building Products*

# *Here's a Sparkling Addition to Sylvania's Popular Troffer Series . .*

Newly installed Sylvania two-foot-wide Troffers with Plastic Lens shielding provide 120 footcandles of quality illumination in the home office of the National Union Fire Insurance Co., Pittsburgh, Pa.

**Architect: William B. Simboli & Associates**
**Consulting Electrical Engineer: Carl J. Long**
**Electrical Contractor: J. W. Hosick**

## Here's What Sylvania's Troffer Line Offers You

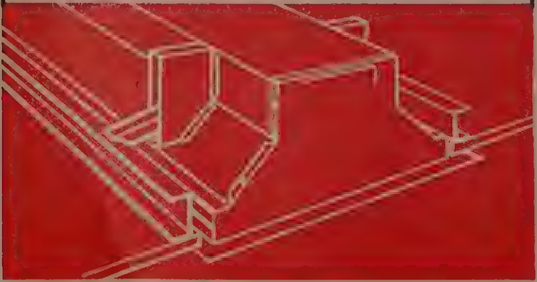
- Only 5½″ deep for ideal ballast operation and convenient relamping.
- Broad choice of widths and lengths.
- 2, 3, 4 and 6 lamp units to meet any lighting requirement.
- Concealed hinges and latches.
- Wide selection of shielding media.
- 3 housing types to fit ALL modern ceilings.
- Simple installation in any ceiling.
- Easy access for maintenance.
- 5 types of Accent Units for pattern lighting.

Sylvania's Troffer Series enjoys tremendous popularity for two basic reasons: (1) outstanding product design together with practical, time-saving features; and (2) an extremely wide range of models to fit all modern ceilings and to suit every individual taste.

Now . . . a NEW addition to the famous Sylvania Troffer family . . . the *Air-Handling Troffer* combining the functions of lighting, heating and cooling into one compact system.

Here is a unit that blends the lighting features and advantages of Sylvania Troffers with the air handling experience of The Pyle-National Company.

With Sylvania's Air-Handling Troffer you obtain the correct, controlled atmosphere so essential for top effi-



## Unique Snap-Up Hanger

The simplest, most effective method of installing troffers in acoustical ceilings and in plaster ceilings with metal framing.

Fixture snaps into place and is supported by toggle arms of Snap-Up Hanger. Positioning and leveling of troffer takes only a few minutes.

ciency working performance. The coordination of mechanical facilities results in excellent overall economy. And uncluttered ceilings, free of separate diffusers, meet the goal of alert designers today.

All of the key features of Sylvania's Troffer Series are incorporated in this new fixture. The air-mixing chamber plus the valve and other air handling accessories combine for a minimum plenum chamber depth for most effective space utilization. The wide selection of fixture sizes, shieldings and number of lamps permits any lighting requirement to be met efficiently and economically.

The low-velocity air-diffusion system provides efficient, uniform air distribution for year-round comfort. Noises, drafts and soiled ceiling areas are minimized. Because the low-velocity system does not depend on walls or partition locations, room space assignments can normally be changed without affecting the efficiency or operation of the air flow.

This combination of quality lighting and efficient air-handling fits well with many building or remodeling plans. Perhaps you can use these convenient, money-saving advantages on your next project. Write today for complete information.

Sylvania Lighting Products
A Division of Sylvania Electric Products Inc.
One 48th Street, Wheeling, West Virginia

SYLVANIA

*Subsidiary of* **GENERAL TELEPHONE & ELECTRONICS**

GENERAL SYSTEM

# KAISER ALUMINUM

# $ COSTS NO MORE TO BUY

## and offers complete assurance

**Contractors everywhere are finding that the old ways aren't necessarily the best ways when it comes to buying and installing rigid conduit. The big money-saver is aluminum . . . for good reasons.**

### 1 Low Initial Cost.

Today, aluminum conduit costs no more than steel . . . an important factor to consider when figuring your bid.

### 2 Lower Installed Cost.

Aluminum conduit weighs only *one-third as much* as the same size steel conduit. Result: easier handling . . . less worker fatigue . . . easier cutting, threading, bending . . . faster, more economical installation.

### 3 Lower Maintenance Costs.

Because aluminum conduit can't rust and is highly corrosion resistant, maintenance and replacement costs are virtually eliminated. Aluminum never needs painting, keeps its look of quality for years. Other quality features: aluminum conduit is non-magnetic, which reduces voltage drop; non-sparking for safe use in hazardous areas; and non-toxic for safe use in food processing plants.

**Your Kaiser Aluminum Electrical Distributor can save you money now!**

The man to see before you bid another job is your Kaiser Aluminum Electrical Distributor. Compare prices—see how Kaiser Aluminum rigid conduit can give you the competitive edge on any contract.

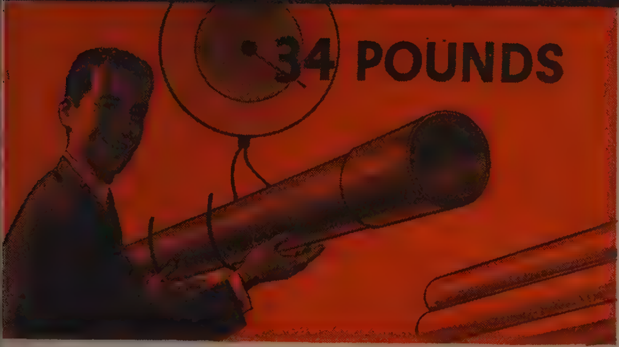
Your Kaiser Aluminum distributor has a complete stock of aluminum conduit sizes and fittings—as well as money-saving aluminum wire and cable—ready for immediate delivery to your job site.

See or call him today. Ask for a free copy of the *Kaiser Aluminum Rigid Conduit Brochure* containing comparative weights, installation details, and all the facts you need to lower your costs.

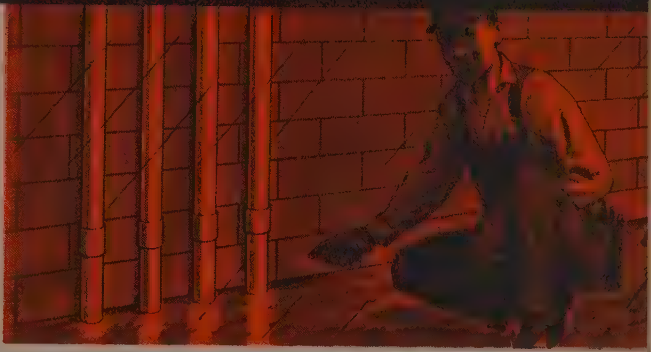
# RIGID CONDUIT

# $ COSTS LESS TO INSTALL

## of a quality installation!



Aluminum conduit is easier and safer to handle. A 10-ft. section of 4-inch aluminum conduit weighs only 34 lbs.; steel—98 lbs.



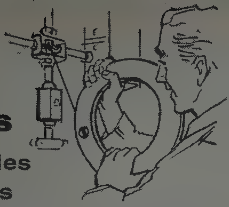
Aluminum conduit can't rust, is highly resistant to corrosion. Your aluminum conduit installation gives years of low-maintenance service.

Aluminum conduit is easier to work with than steel conduit. Easier handling saves you time, labor and money.

KAISER ALUMINUM

Kaiser Aluminum & Chemical Sales, Inc.
Kaiser Center, 300 Lakeside Drive
Oakland 12, California

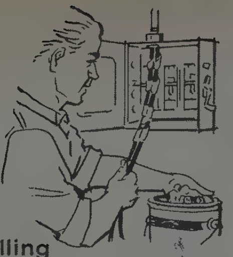
IDEAL
the helping hand on every wiring job...
Ferrules
IDEAL
electricians' tools
2
1
ELECTRICIANS'



## FISH TAPES

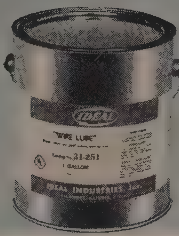
**Four styles fit all jobs**

Pulling wire is part of almost every job. So why not have the best tape? Ideal offers 4 different types of steel tape to make any pull easier. Oil-tempered flat spring steel, extra-flexible "Coil-Flex" made of spring steel wound around flexible tape, Nylon-insulated round tape for "hot" jobs, and the amazing new "Flexi-Strand" for the sharpest bends you can make in conduit. All Ideal tapes use easy-grip tape reel to retain tape securely. You get easier pushing and pulling with Ideal fish tapes.



## "WIRE-LUBE"

**For easier wire pulling**

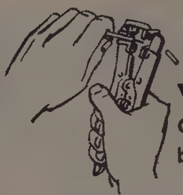


Hanging-up on the sharp bends? Squeezing big wires into small conduit? Having any kind of pulling problem? Then you need Ideal "Wire-Lube" to smooth the way. Apply by hand or brush, and wires easily slide without breaking or scraping insulation. "Wire-Lube" dries to a fine lubricating powder that makes it easy to pull wires later, too. Absolutely safe, non-corrosive, non-combustible.

Frankly, our objective here is to remind you that the world's most popular wire connector, "Wire-Nut"®, and other Ideal connectors are only *part* of the Ideal "Helping Hand" product line.

Ideal makes tools and products to assist you on virtually every step of every wiring job. All are top quality sold at a modest cost. That's honest value.

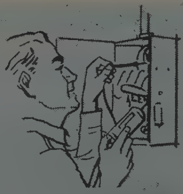
On this page we've briefly described a few Ideal products that can make your job easier. You'll find many more listed in the Ideal Contractors' & Electricians' Catalog. If you don't have a copy of your own, just mail us the coupon below, and we'll rush one right to you. You'll be surprised how many work-saving ideas and products you'll find packed in its pages.



## WIRE STRIPPERS

**One squeeze bares any wire**

Thick, thin, vinyl, teflon . . . whatever the insulation you must strip, an Ideal wire stripper is the easiest way. So drop that pocketknife; spare your thumb! There's an Ideal pocket-type stripper or cable ripper to do the job right . . . no damaged insulation or ringed conductors to cause future trouble. Ruggedly built and easy to use, Ideal wire strippers are real mechanics' tools for everyday use.



## VOLTAGE TESTER

**Super-safe 2-way testing**

Safest, easiest-to-use voltage tester made. Designed for rugged daily use. Case is seamless plastic in Safety Yellow, with no surface metal. Prods have extra-safe no-slip grips and 30" neoprene leads. Solenoid calibrated voltage indicator functions separately from neon test lamp for super-safety. Available with special current-limiting resistors in each prod. Ideal also offers a Test-Glo circuit tester, and a continuity tester.

**IDEAL**

***SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS***

*In Canada: Irving Smith, Ltd., Montreal*

**IDEAL INDUSTRIES, Inc.**
1041-G Park Avenue, Sycamore, Illinois

**Yes! I want a copy of the new Ideal Contractors' & Electricians' Catalog.**

Name ____________________

Firm ____________________

Address ____________________

City ____________ Zone ______ State ______

©1960, IDEAL INDUSTRIES, INC., SYCAMORE, ILL.

# NOW ...a

# electrical failures corrosive atmospheres

Moisture effects changes in physical and electrical characteristics of electrical and electronic equipment that lead to costly downtime, repairs or replacement. The overheating, burning, sparking and eventual failure of contacts due to corrosion is one example of this waste. Another is failure of electric motors in humid locations due to the gradual absorption of moisture.

The dual-action of CRC 2-26 eliminates or greatly reduces this damage and deterioration. It separates water from the surface of plastics, metals, rubber, paint and removes moisture from minute holes and cracks. It leaves a thin, protective film which acts as a barrier. Corrosive action is both stopped and prevented from recurring.

The CRC 2-26 film is very thin, being measured in millionths of an inch, and does not change dimensional characteristics nor affect contact resistance. It does not become dry, hard or brittle and will expand and contract with temperature changes to maintain its continuity of coverage.

By sealing the pores and scratches in painted and plated surfaces, CRC 2-26 prevents rust and corrosion by preventing moisture from reaching the bare metal. By sealing plastic surfaces, CRC 2-26 prevents dimensional and resistance changes that accompany moisture adsorption.

Neither irritating to the skin nor toxic, and having a high flash-point, CRC 2-26 is easily applied without special precautions.

CRC 2-26 is not an acrylic, a lacquer, a silicone or a petroleum derivative, nor does it have the limitations associated with these materials.

CRC 2-26 is widely used by large industrial corporations and government installations. It maintains equipment year after year that has previously burned out or needed extensive servicing every few months.

*Write for complete information to Corrosion Reaction Consultants, **116-A** Chestnut St., Philadelphia 6, Pa., or telephone WAlnut 5-0200.*

A SUBSIDIARY OF THE CHAS. J. WEBB SONS CO., INC.

LISTED UNDER REEXAMINATION SERVICE OF UNDERWRITERS' LABORATORIES, INC. UL

**CRC® 2·26 LOW-COST PROGRAMS**

# *simple, effective, low cost method of preventing due to moist and*

## CRC® FORMULA 2·26 FOR THE ELECTRICAL INDUSTRY

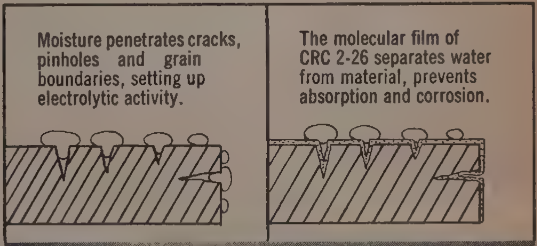
**Typical equipment maintained by CRC 2-26.**

SWITCHES
SWITCHGEAR
CIRCUIT BREAKERS
CONTACTORS
FUSES
FUSE HOLDERS
RELAYS
SOLENOIDS
RECTIFIERS
TRANSFORMERS
PLUGS AND RECEPTACLES
BULBS AND SOCKETS
MOTORS
GENERATORS

CABLES
INSULATION
COILS
INSTRUMENTS
METERS
TIMERS
BUS BARS
PORTABLE TOOLS
WELDERS
CONDUITS
FIXTURES
HOISTS
LIFT TRUCKS
PANELBOARDS
BLOWERS
FANS

SIGNALS
ALARMS
CONTROLS
RECORDERS
SHIELDING
COUNTERS
ELEVATORS
HOUSINGS
CABINETS
CHASSIS
OSCILLATORS
POTENTIOMETERS
FILTERS
RHEOSTATS
SUB-ASSEMBLIES

SYNCHRONIZERS
TRANSMITTERS
RECEIVERS
TESTERS
EXCITERS
BATTERY TERMINALS
IGNITION SYSTEMS
HEAD SETS
MICROPHONES
SPEAKERS
TUBES
PLASTICS
PAINTED AND PLATED SURFACES



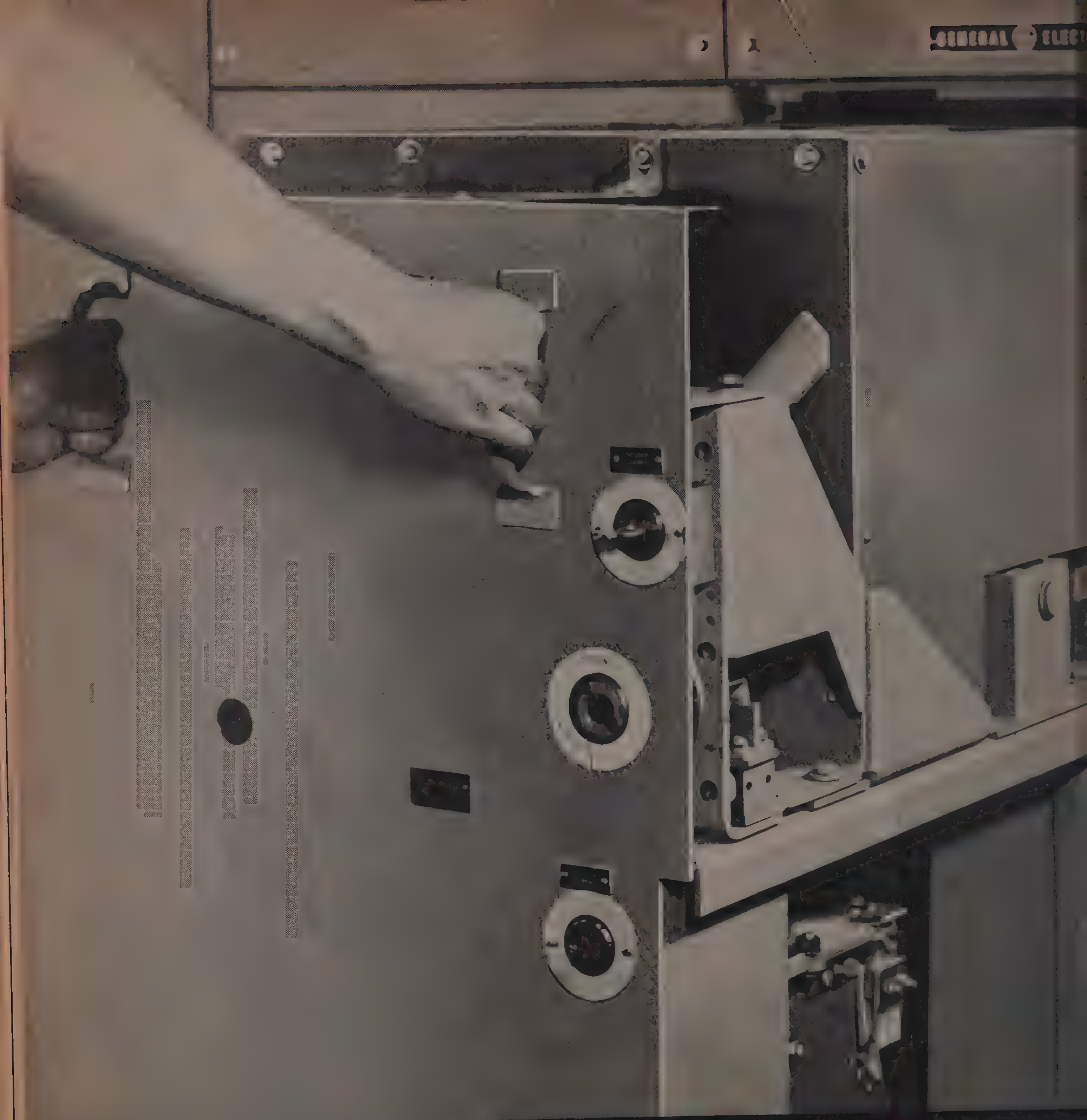
Moisture penetrates cracks, pinholes and grain boundaries, setting up electrolytic activity.

The molecular film of CRC 2-26 separates water from material, prevents absorption and corrosion.

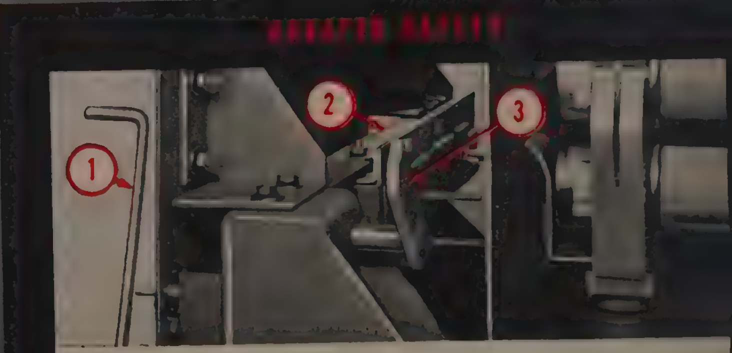
Supplied in 16 oz. aerosol cans, 1 and 5 gal. cans, 55 gal. drums.

## FOR PREVENTIVE MAINTENANCE

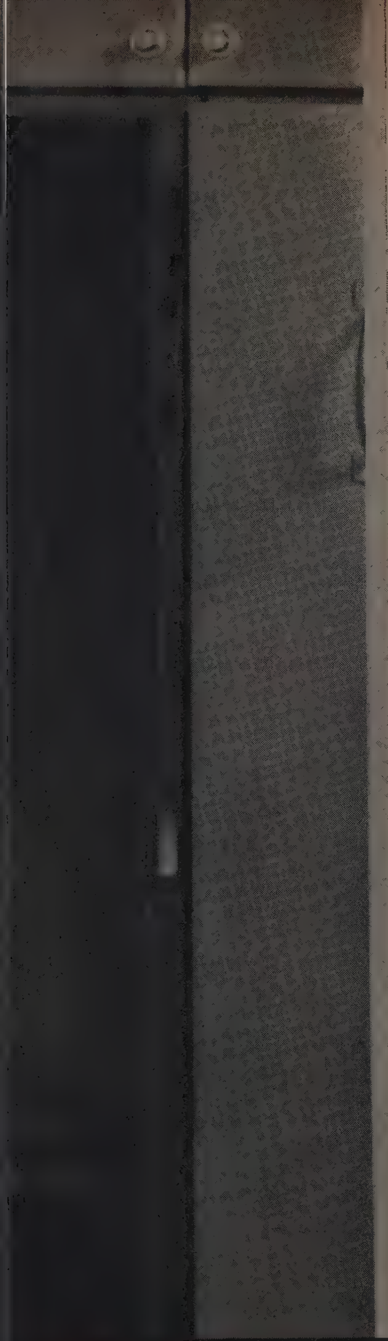
*Place your order now with your Electrical Distributor*



**AS ACCESSIBLE AS A FILE DRAWER,** G-E Roll-out Switch and Fuse Equipment (available in 2.4 to 13.8 kv ratings) combines maximum safety with ease of inspection and maintenance.



**YOU GET GREATER SAFETY** because (1) new, removable, single-stroke handle "charges" the operating spring safely, easily. (2) High speed closing and consistent contact opening are provided by one spring which works independently of operator. (3) Positive interlock gives greater safety for operator and equipment.



*Here's how*
*General Electric*
*Rollout Switch and*
*Fuse Equipment makes...*

# TH
# BIG
# DIFFERENC

## *in reducing fixed and operating costs for light duty switching and circuit protection*

Greater safety, better short-circuit protection, easier installation, and reduced maintenance—these are the features of General Electric Rollout Switch and Fuse Equipment that play an important role in reducing your fixed and operating expenses.

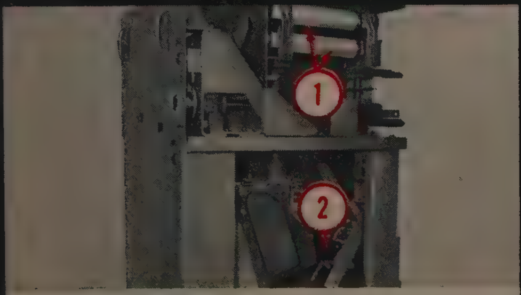
Precision-engineered components make another "Big Difference." A new manually-operated, stored-energy load-break switch provides both high-speed closing and consistent, sure contact opening independent of the operator. High quality current-limiting fuses and interrupter switches help assure rapid, sure switching and fault current protection.

Evaluate for yourself the difference this equipment can make in both commercial and industrial systems. For all the facts, contact your nearest G-E Apparatus Sales Office or write for bulletin GEA-6623B, General Electric Co., Schenectady 5, New York. 514-06

*Progress Is Our Most Important Product*

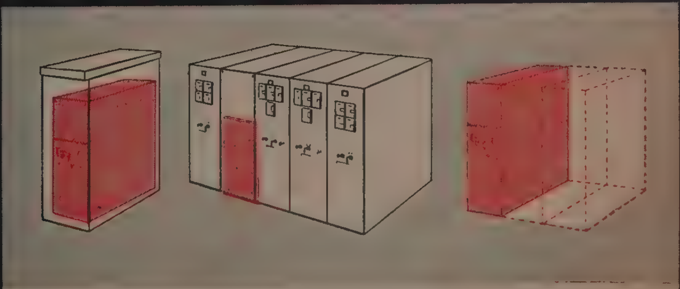
**GENERAL ELECTRIC**

**BETTER SHORT-CIRCUIT PROTECTION**

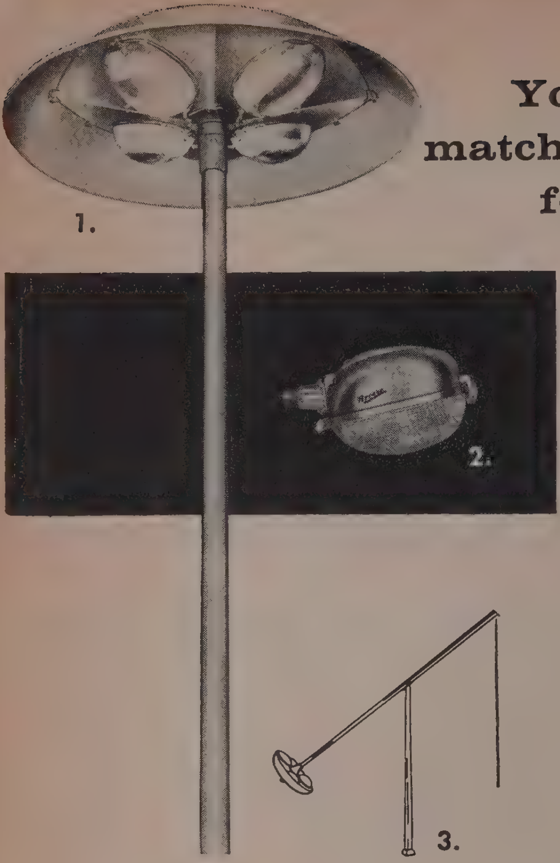


**GENERAL ELECTRIC ROLLOUT SWITCH AND FUSE EQUIPMENT** has (1) current-limiting fuses on the source side of the (2) load-break switch. This feature means you get greatly improved short-circuit protection.

**GREATER INSTALLATION VERSATILITY**



**YOU HAVE A CHOICE** of construction types. G-E Rollout Switch and Fuse Equipment can be furnished to suit your installation needs—indoor or outdoor units; in line-up with G-E Metal-clad Switchgear; or in single or multiple units.



# Your Revere wholesaler offers matched, easy-to-install equipment for every outdoor lighting job

Revere offers the widest selection of high-quality outdoor lighting equipment available from any single manufacturer . . . floodlights, luminaires, poles and all accessories. Every component you select is design-matched to every other component for easy installation, structural strength and balance, and peak lighting efficiency. Ask your Revere wholesaler about the advantages of Revere incandescent, mercury, or fluorescent outdoor lighting for your next job. You'll be pleased with on-time delivery of components to your job schedule . . . you'll be pleased with the way design-matched Revere equipment reduces call-backs.

**Revere® ELECTRIC MFG CO**

**OUTDOOR LIGHTING EQUIPMENT**

**Revere Electric Mfg. Co.** • 7420 Lehigh Avenue • Chicago 48, Ill.
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200

1. **Revere Ultra-Lites** *are attractive and efficient for illuminating large areas brightly and uniformly. Each Ultra-Lite houses four 400-watt mercury lamps positioned to throw a square light pattern with wide coverage that cuts pole requirements 50 to 75%.*

2. **Endoval luminaires** *are used to light shopping-center parking lots, automobile sales lots, store fronts and similar applications where high intensity, glare-free light is desired. Uses 250 or 400-watt mercury lamps.*

3. **Revere hinged poles** *make for safe, economical lamp maintenance at ground level. Eliminates need for boom trucks or ladders.*

4. **4200 Series** *floodlights provide efficient large-area lighting for sporting fields, storage yards, buildings, etc., using 750, 1000, or 1500-watt incandescent lamps with wide or narrow-beam reflector.*

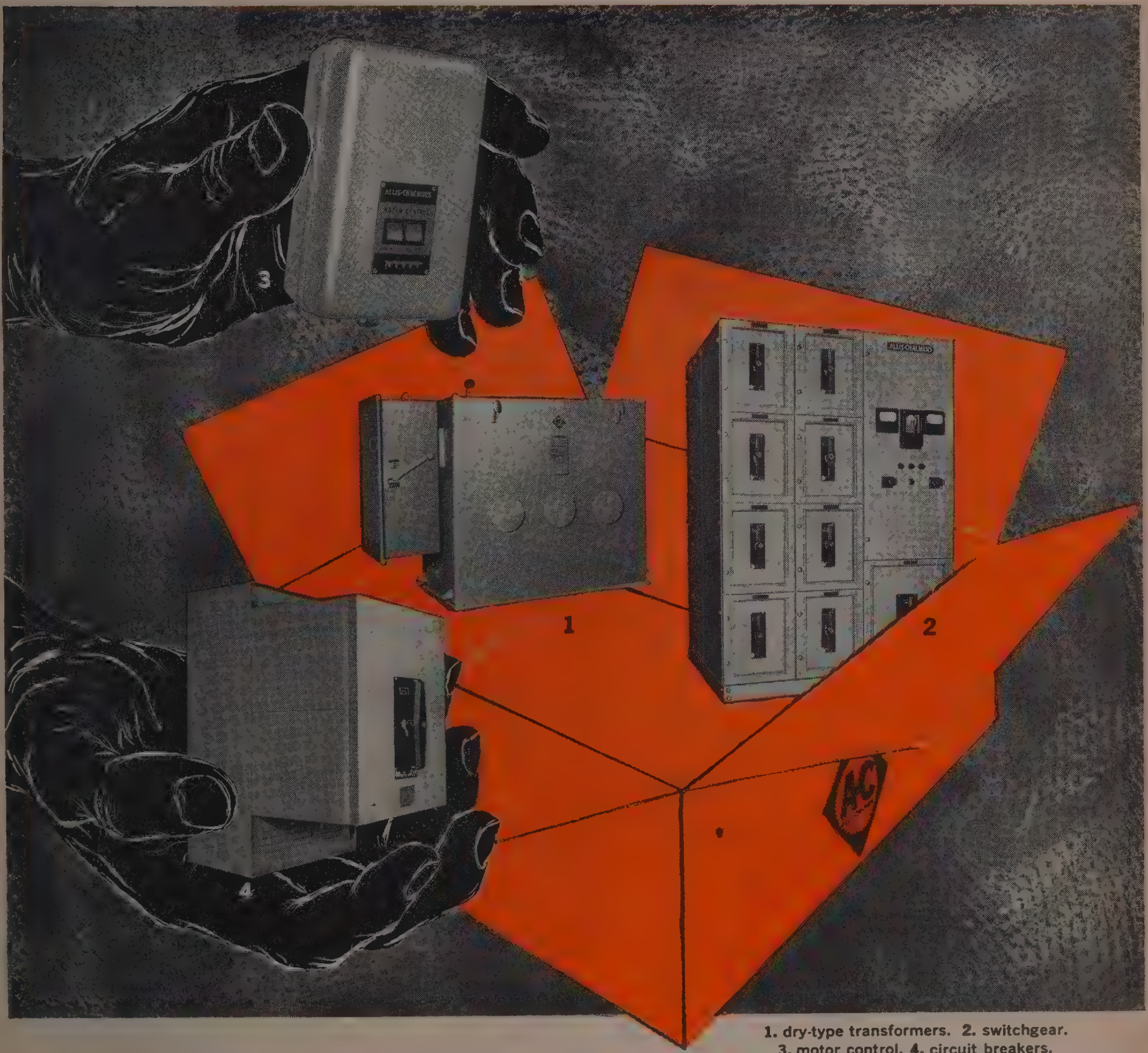
5. **7400 Series** *floodlights use 1000-watt mercury lamps to provide exceptionally high light output for railroad yards, sports fields, parking lots and other large-area applications.*

6. **3800 Series** *Eliptor floodlights are an economical source of high intensity lighting for smaller area, general-purpose applications. Eliptor floodlights are available for 300- to 1500-watt incandescent lamps.*

7. **3151 Series** *underneath floodlight provides unusually attractive lighting effects for buildings or other vertical surfaces.*

8. **Fluoresign** *outdoor luminaire is highly efficient, economical way to illuminate poster panels, store fronts, highway signs, painted walls and other surfaces, using HO, VHO, SHO or Power Groove lamps.*

ALLIS-CHALMERS



1. dry-type transformers. 2. switchgear.
3. motor control. 4. circuit breakers.

Allis-Chalmers system-selling package concept

**wraps up new profits for you**

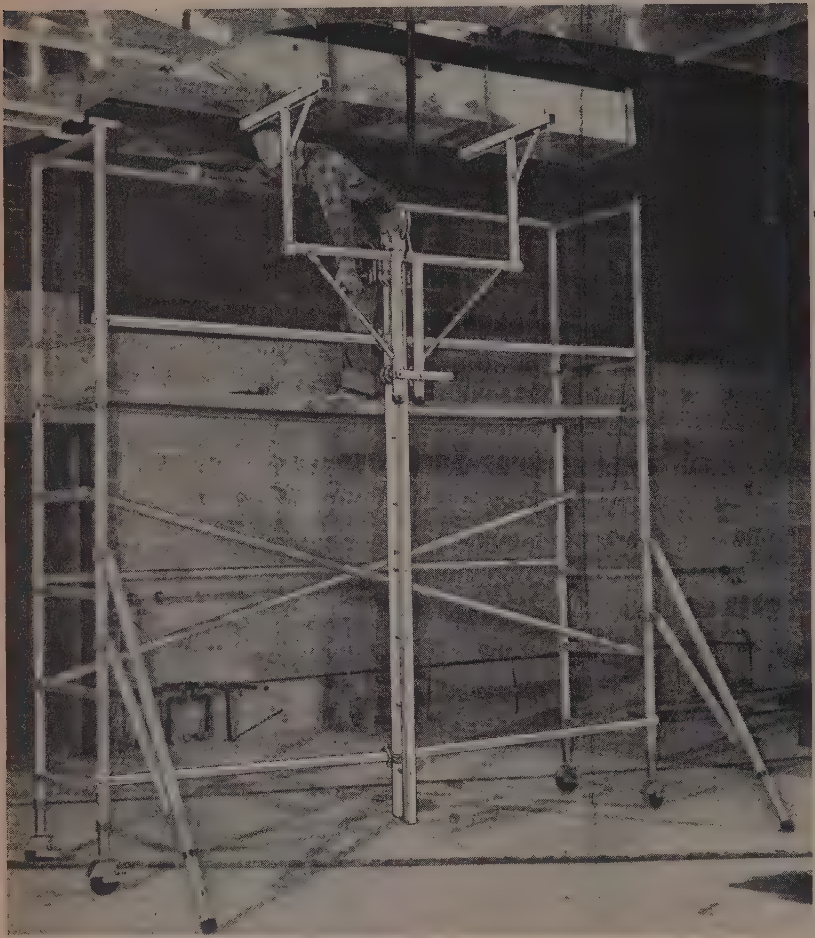
**One man gives you all** the electrical products for wrapping up new profits on system sales and installations! One man coordinates specs, orders, delivery, installation scheduling. One man personally represents Allis-Chalmers — exercises single-source responsibility from initial planning to startup and he is ready to follow through on fast spare parts action.

Why not wrap up new profits by eliminating needless multiple supplier headaches? You can accomplish this with the Allis-Chalmers system-selling packaged products shown on the following pages. *Your nearby A-C office can quickly give you the complete facts, or write* ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

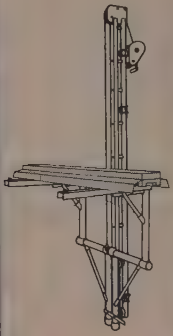
A-1267

*Double your workman's production...*

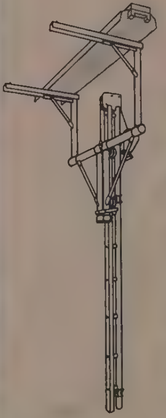
# UP-RIGHT mechanical man lifts & positions material for fast, one-man installation



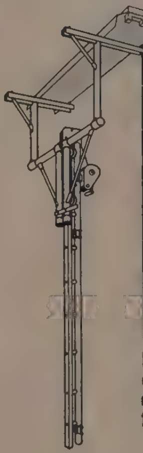
Workman and mechanical man accurately position 9 ft. long air duct for easy, rapid installation.



Fixture is placed on lifting arms at convenient chest height.



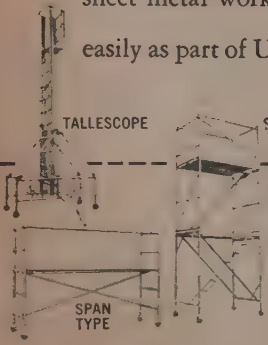
Fixture is elevated along vertical track by winch.



Lifting arms move horizontally on rollers and elevate fixture to desired position above workman for fast, convenient installation.

*Mechanical man* is an aluminum hoist assembly instantly attachable to any Up-Right or other scaffold. It saves fatigue and manhours in positioning fluorescent fixtures, bus-ducts, conduit, pipe and sheet metal work for overhead installation at any height. Rolled easily as part of Up-Right aluminum scaffold.

*Write for descriptive circular*



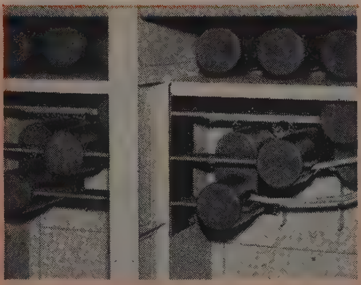
**UP-RIGHT SCAFFOLDS**

DEPT. 177 1013 PARDEE, BERKELEY, CALIFORNIA

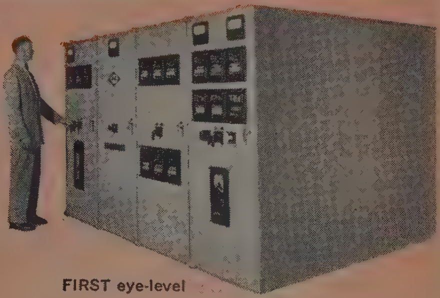
In Canada: Up-Right Scaffolds Ltd., 120 Russet Ave., Oshawa, Ontario

# ALLIS-CHALMERS

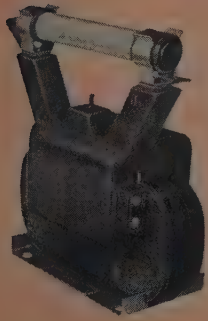
FIRST static overcurrent relays



FIRST with track-resistant, glass polyester insulation with primary stud and bus joint



FIRST eye-level instrumentation switchgear

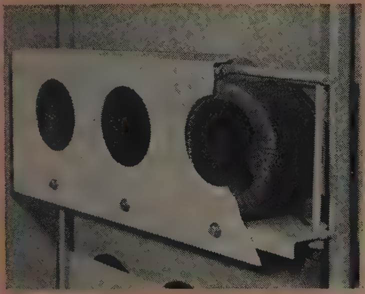


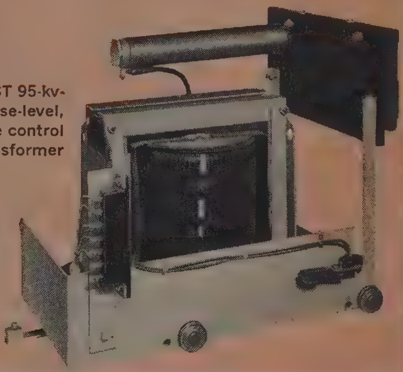
FIRST epoxy-resin potential transformers, trunnion mounted

# 1ST

FIRST Aluma-Clad walk-in aisle switchgear

FIRST front-access current transformers





FIRST 95-kv-impulse-level, dry-type control power transformer

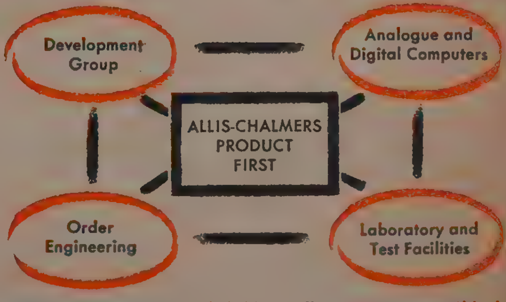
## . . . from the company that put

# Progress in Switchgear

**For 113 years Allis-Chalmers has built a reputation for the finest products in the industry.** A-C is continuously developing new ideas, new techniques and new products to serve you better. This same leadership spirit has quickened the pace of switchgear progress. It's responsible for the firsts illustrated above. These testify to one company's research and engineering *action.*

There are still better things to come in switchgear. You'll get them all when you specify better switchgear . . . designed, built and *guaranteed* by **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin. A-1357

*Aluma-Clad is an Allis-Chalmers trademark.*


Development Group
Analogue and Digital Computers
ALLIS-CHALMERS PRODUCT FIRST
Order Engineering
Laboratory and Test Facilities

Intradepartment teamwork bridges all gaps . . . smoothly integrates information, machines and men . . . speeding overall progress in Allis-Chalmers switchgear.

**Your cheapest insurance against sudden darkness**

When the lights go out, Exide Lightguard® goes on automatically. It protects you from panic, damage and pilferage when power sources are interrupted. Plugs into a regular outlet—charges itself automatically—provides light when you need it the most.

Exide Lightguard comes in three different models designed to your needs. Be protected—write for full details. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

**Exide®**

# ALLIS-CHALMERS

Now — faster, easier hookup with new, 3-piece case design.

# All-new dry-type transformers

## ...on the wall, wired, closed in half the time!

**Now 35% smaller, lighter** — new Allis-Chalmers ventilated, dry-type transformers feature exclusive 3-piece case that cuts installing time from 90 to *just 40 minutes!* New, compact size opens additional installation site possibilities previously considered too tight for conventional units.

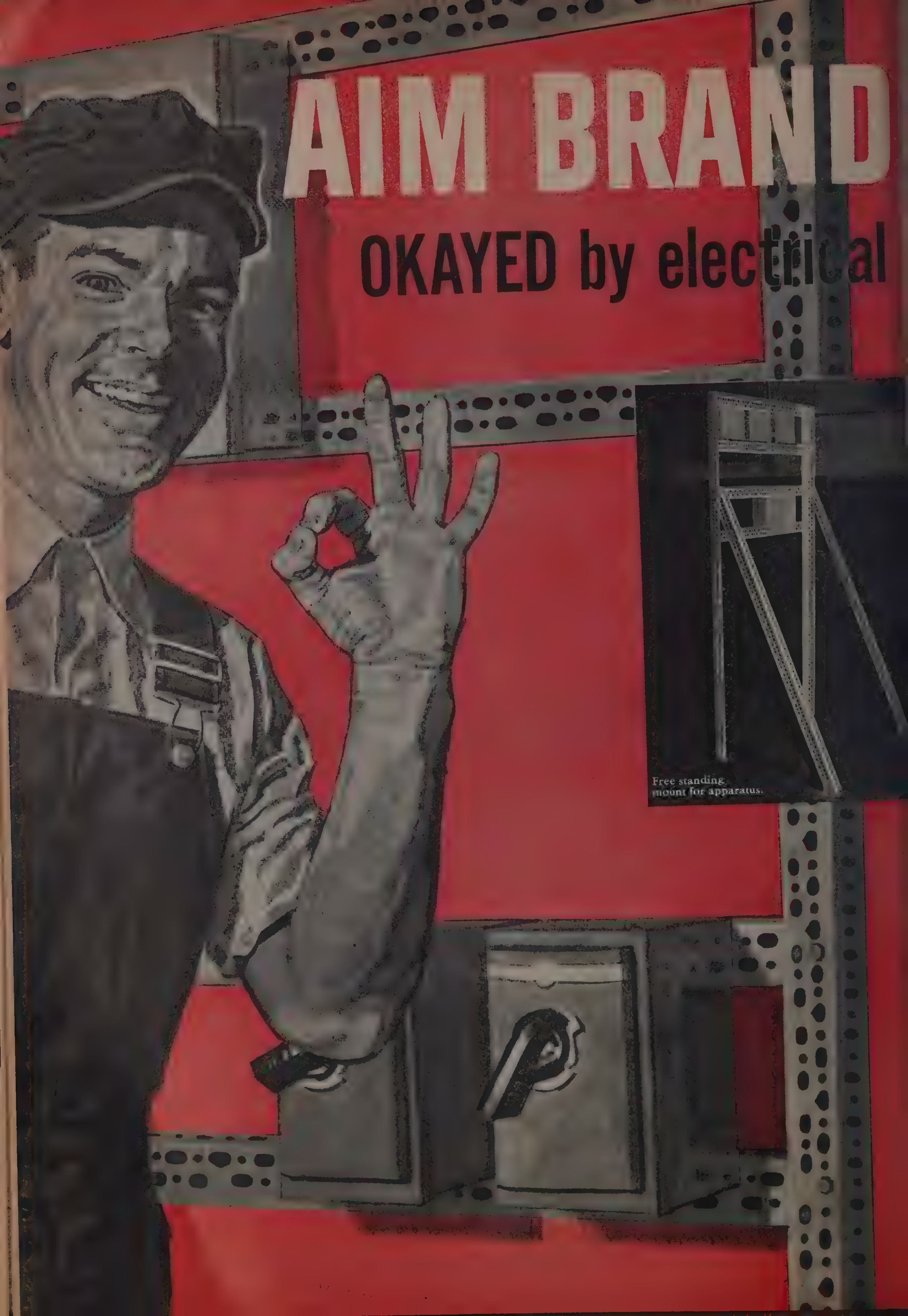
Noise level is reduced to no-hum, whisper-quiet operation by employing core impregnation . . . by isolating core-and-coil assembly from the case . . . and by use of nonresonate casing. Low core losses and low exciting current result from superior *Curvacore* construction.

This new 600-volt class indoor transformer line is available in 3- to 50-kva sizes for on-the-site load center applications where critical voltage must be maintained. And the price is right!

Further details are available in Bulletin 61B8222A at your nearby A-C office, or write **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin.

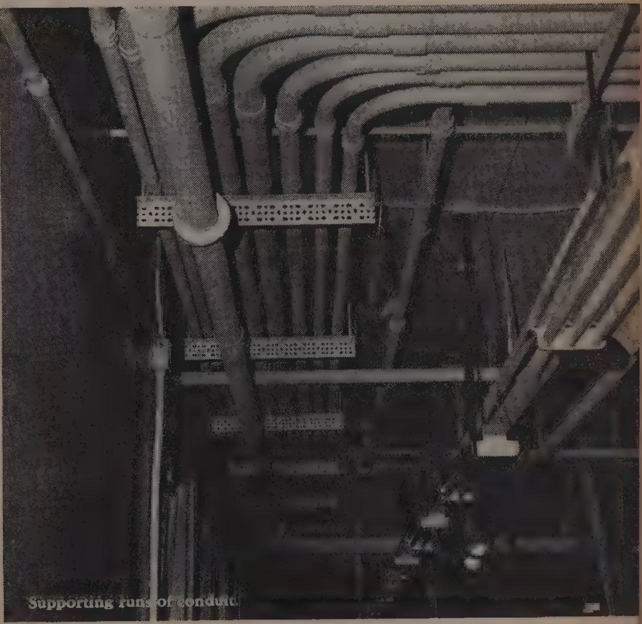
Curvacore is an Allis-Chalmers trademark.

A-1359


AIM BRAND
OKAYED by electrical
Free standing mount for apparatus.

# SLOTTED ANGLE

# contractors on thousands of jobs



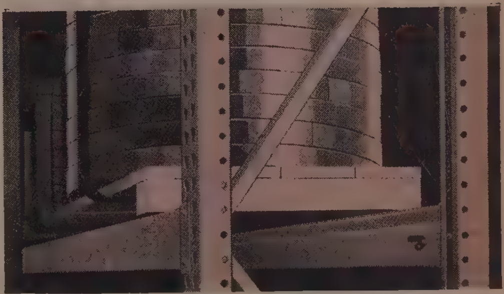
*Electrical contractors are proving it every day!* For framing, mounting and hanging electrical apparatus, AIM Brand Slotted Angle offers virtually unlimited economies, uses and design freedom.

**Simple.** Free your skilled men for other jobs—an apprentice or helper can master it in minutes. A hand wrench is all that's needed—no drilling, sawing, welding.

**Fast.** Once lengths are figured, they're quickly snipped to size with the AIM Brand Cutter. Marks every 3 inches speed measurements. Pieces simply bolt together. ⅜″ holes accept all standard electrical fittings—no reaming or special adapters required.

**Obsolete-proof.** Say specs change—more runs of conduit are required. No loss—add on to the AIM Brand Slotted Angle and you're all set.

**Giant savings.** All savings totaled—initial material cost, handling, sizing, cutting and assembly time—job costs can be cut as much as 40% on every installation! AIM Brand is distributed nationally. For the name of your nearest distributor and free, illustrated booklet, contact your nearest ACME STEEL office or ACME STEEL COMPANY, Fabricated Materials Division, Dept. EAD-70, 135th Street & Perry Ave., Chicago 27, Ill.



Acme Steel AIM Brand Rack for heavy-duty storage offers greater stability, installation ease and tested load capacities.

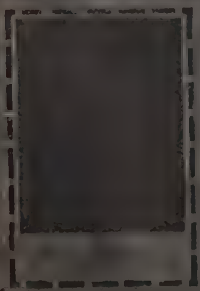
Exclusive safety load locking device* and two button head studs provide three point bearing per beam connection for positive protection against accidental disengagement of beams. Write for details.

*Patent applied for

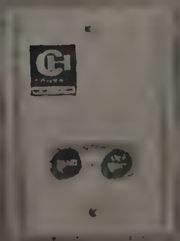
ACME STEEL

IDEA LEADER IN
FRAMING

AIM
BRAND



**Smaller!** About 20% smaller than Size O Starters. Just 5 3/4" wide, 7" high and 4 3/16" deep.



**Convertible!** Carried in stock with three cover options or easily converted in field from "reset" only to "start and stop-reset" or "three-position selector switch." Kits at optional cost.

**Broad line!**

CONTROL

*A new addition to the famous three star line*

# New! Save space and money with Cutler-Hammer's Size 00 A-C Magnetic Starter

**Takes up to 20% less space . . . costs 18% less than Size O Starters.** Now you get two big new bonuses in control selection . . . less space and less money Both with the all new Size 00 Starter.

Before, you had to use a larger starter in applications where it really wasn't needed. But, now you can use the Size 00 in about 40% of the applications where the Size 0 is usually used.

The new Cutler-Hammer Size 00 Starter performs to the same high standards you get from all Cutler-Hammer Starters. And, you still get vertical, dust-free contacts which add so much to more reliable starter performance. Your choice too, of 2-coil or 3-coil overload protection in the same small enclosure.

The Bulletin 9586 Size 00 Starter can be used on any general application. Its maximum horsepower ratings: Three phase: 208/220 volts, 1½ hp. 440/550 volts, 2 hp. Single phase: 115 volts, ⅓ hp. 230 volts, 1 hp. It's available open or in NEMA 1 enclosure. Send for Pub. LO-40-N241.

**Why you get more from Cutler-Hammer.** New things are happening at Cutler-Hammer—new, better products, new engineering ideas and talent, new plant capacity. We're on the move. And, we'd like to show you how we could help you in any electrical control problem. Contact the nearest Cutler-Hammer distributor.

*WHAT'S NEW? ASK...*

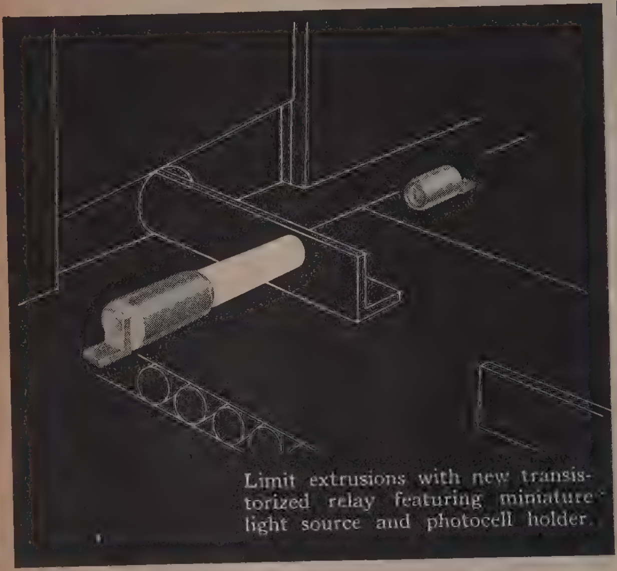
**CUTLER-HAMMER**

CONTROL

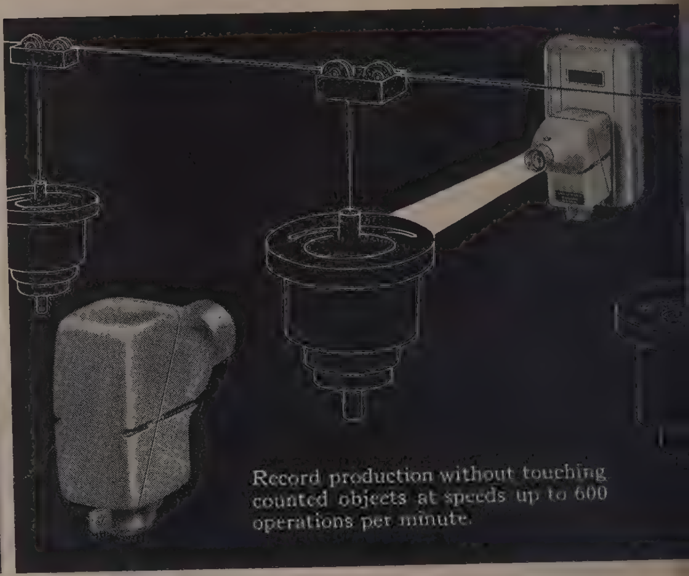
**Cutler-Hammer Inc.**, Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A

FOR QUALITY . . . PRODUCTIVITY . . . PROFIT . . . MODERNIZE WITH GENERAL ELECTRIC

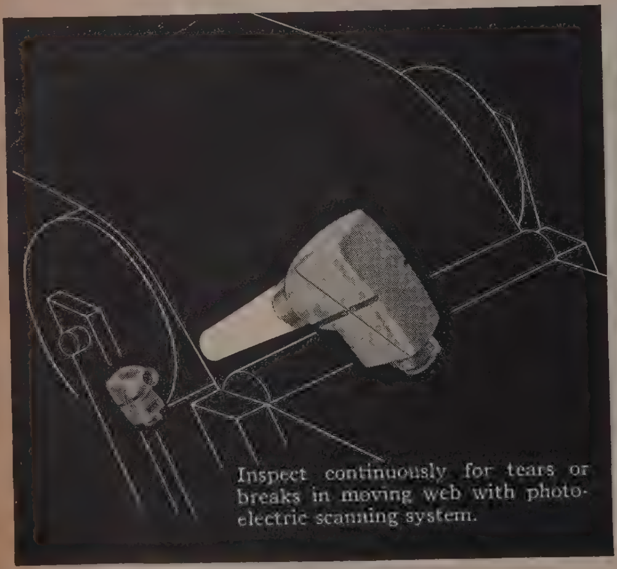
## LIMITING


Limit extrusions with new transistorized relay featuring miniature light source and photocell holder.

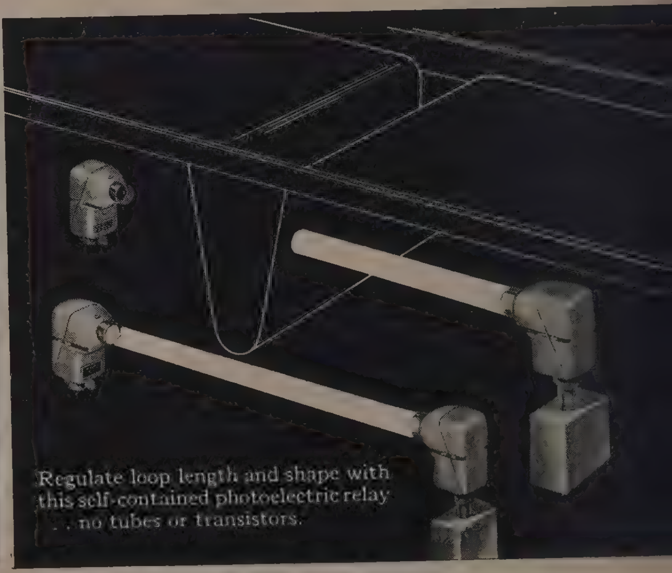
## COUNTING


Record production without touching counted objects at speeds up to 600 operations per minute.

## DETECTING


Inspect continuously for tears or breaks in moving web with photoelectric scanning system.

## CONTROLLING


Regulate loop length and shape with this self-contained photoelectric relay . . . no tubes or transistors.

## A COMPLETE LINE OF GENERAL ELECTRIC CONTROL DEVICES

**Photoelectric controls**
- General-purpose
- High-speed
- Long-distance

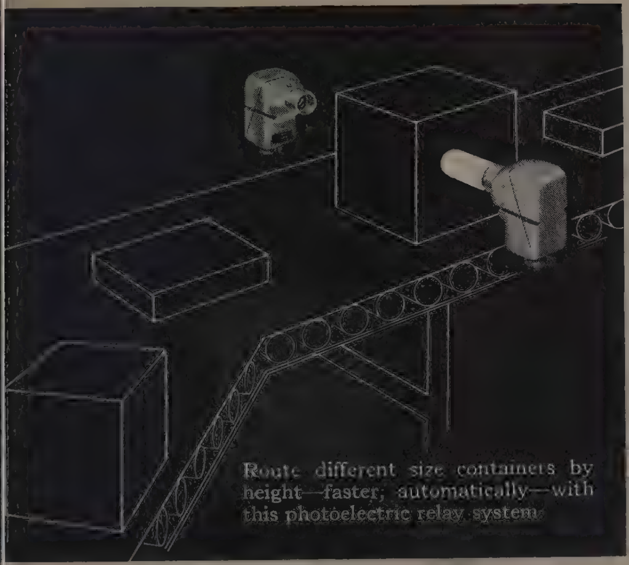
**Electronic devices**
- Timers
- Resistance-sensitive relays
- Voltage-sensitive relays

**Photoelectric systems**
- Smoke-density indicators
- Side-register controls
- Cut-off register controls

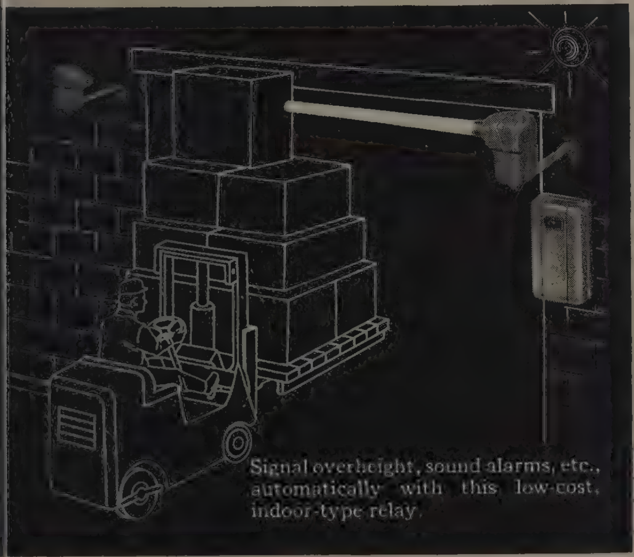
**CONTROLS**
**FOR AUTOMATION**

**PHOTOELECTRIC CONTROLS**

# SORTING


Route different size containers by height—faster, automatically—with this photoelectric relay system.

# SIGNALLING


Signal overheight, sound alarms, etc., automatically with this low-cost, indoor-type relay.

**Switching . . . inspecting . . . counting . . . diverting . . . sorting . . . controlling.** These are but a few of the *hundreds* of applications where General Electric photoelectric controls are helping our customers move closer to the benefits of automation—increased productivity, lower costs, higher quality.

Users are finding *new* ways to fit General Electric photoelectric devices into their production processes every day . . . for good reasons: These versatile G-E controls are designed for heavy-duty industrial use. They're easy to install, and require virtually no maintenance. They are highly dependable throughout a long operating life. In fact, General Electric photoelectric controls feature lamps with life expectancy of 10,000 hours—more than a year of round-the-clock operation!

### ONE-YEAR WARRANTY, IMMEDIATE STOCK SHIPMENT

General Electric photoelectric and electronic devices carry a standard one-year warranty for your protection. And, your order for standard catalog devices is filled immediately from one of six regional warehouses. Also, replacement parts are warehouse-stocked, too, for your convenience and protection.

For expert help in applying General Electric photoelectric devices to your operations, call your nearby G-E Apparatus Sales Engineer or Distributor today. And, for your personal copy of our Photoelectric Devices catalog, mail the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

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**Schenectady 5, New York**

Please send me a copy of the G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

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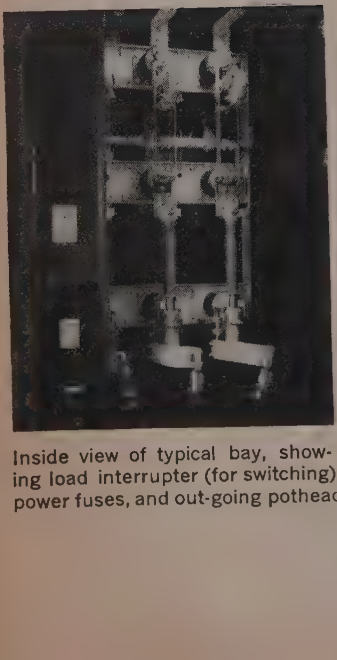
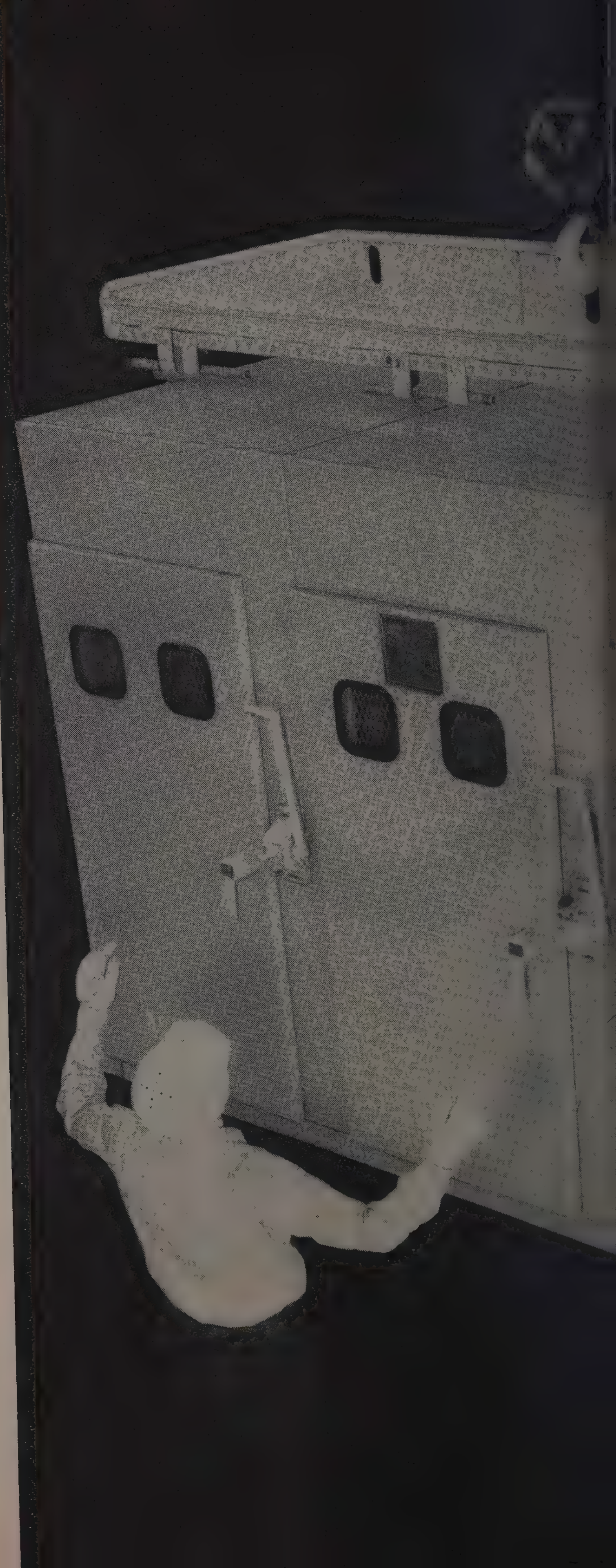
# FAULT PROTECTION

## ONLY 125 LB. PER SQ. FT.



Inside view of typical bay, showing load interrupter (for switching), power fuses, and out-going pothead.



# S&C Metalclad Switchgear weighs 60% less — requires 50% less floor space

This S&C Metalclad Switchgear unit, rated 13.8 kv, weighs only 4500 lb., requires only 36 square feet of floor space (excluding aisle space), yet costs only $5,000. Why? Through the simplicity of S&C's design. Power fuses provide fault protection and load interrupters do the switching. Result: the most dependable yet most economical protection possible for high voltage power circuits in industrial and commercial installations. Besides initial low cost here's how else you save:

**Low installation costs.** Because S&C switchgear is lighter it's easy to uncrate, handle and move into place. Often you can utilize space on roofs or balconies without the expense of reinforcing. The S&C unit shown here weighs only 125 lb. per square foot—60% less than other types of metalclad switchgear.

**Less floor space.** S&C switchgear is shallower. (The unit shown here is only three feet, eight inches deep.) It can be backed against a wall since rear access is not required. No extra floor space is needed at the front for drawout. So you can cut your floor requirements 50%.

Power fuses give protection against permanent destructive faults. Industrial and commercial high-voltage power circuits are not subject to transient faults and so don't need the automatic reclosing feature of the circuit breaker.

S&C fused interrupter gear meets the new National Electrical Code requirements for fault closing. It is available in short circuit interrupting ratings up to 500 mva at 14.4 kv, 250 mva at 4.16 kv. Continuous current ratings are 200, 400, and 720 amperes. Maximum capacity of main bus, 2000 amperes.

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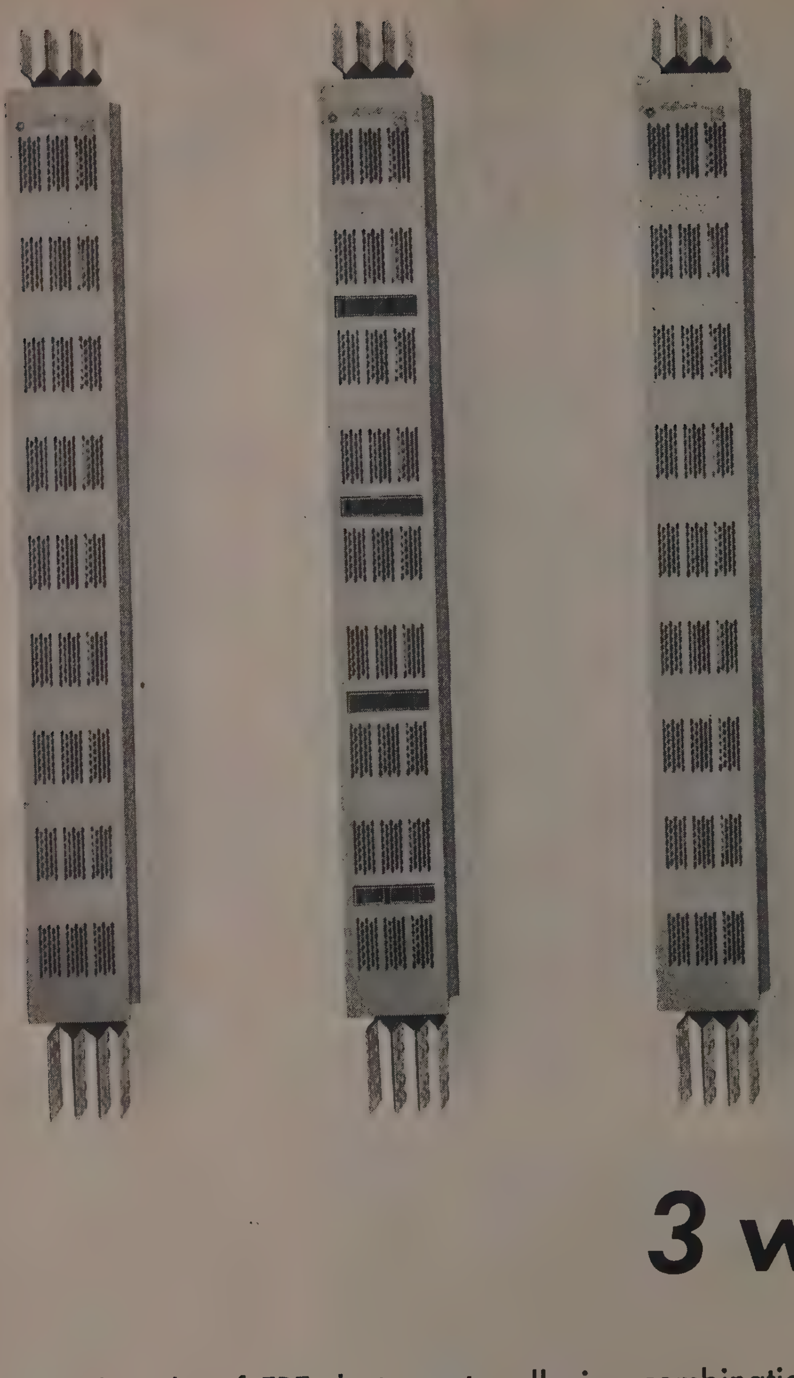

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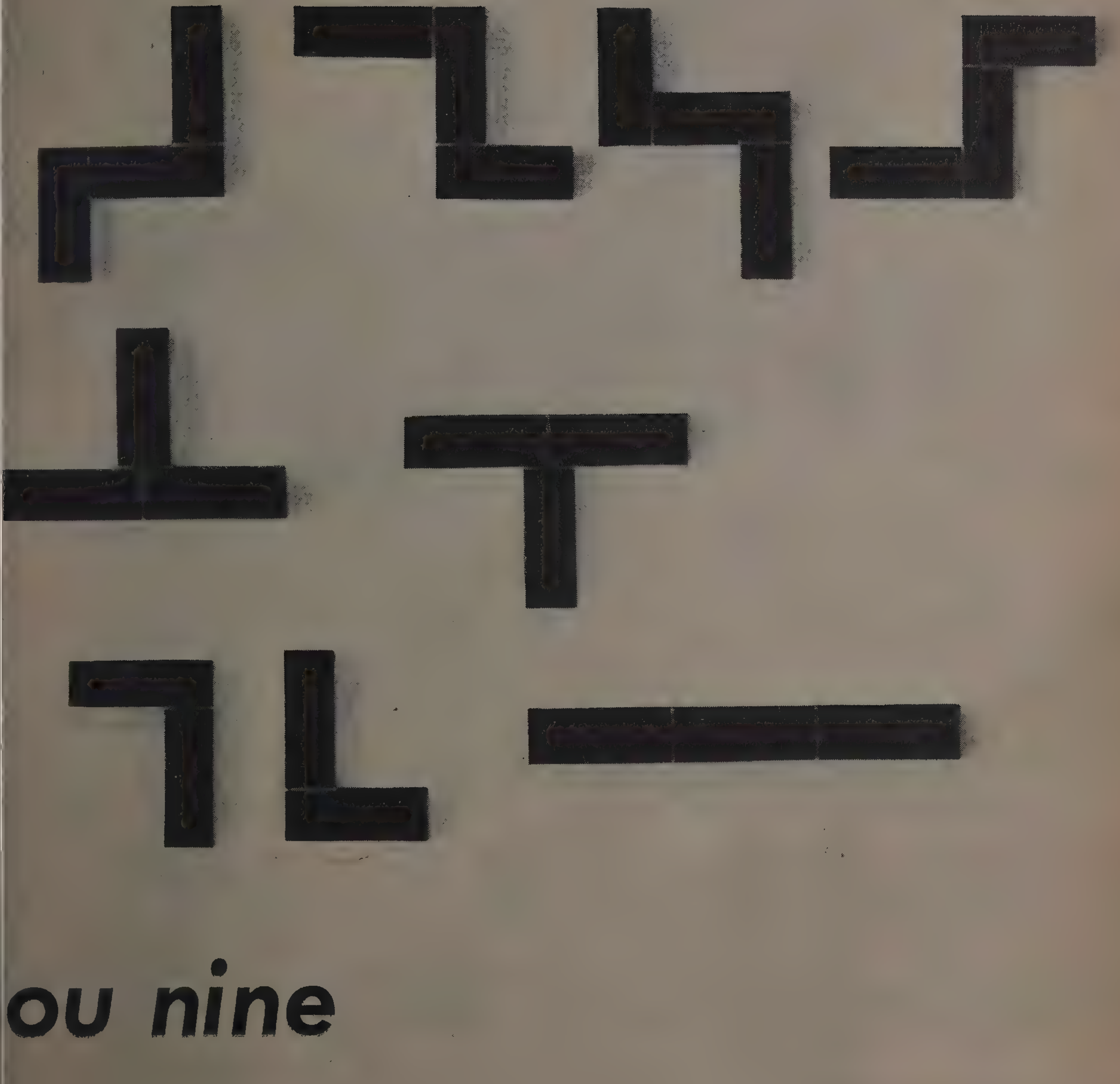
Three straight lengths of FPE duct create all nine combinations shown—*right on the job*. Federal Pacific low impedance or low impedance plug-in ducts bolt together for tees, elbows and offsets in limitless application. And your savings are just beginning: no delivery delays...installation costs cut as much as 30%...flexibility and expandability multiplied several times over. What's



**ou nine**

more, you can relocate in new layout, and again, no need to wait for factory fittings. All this because Federal Pacific designs bus duct on the modern modular principle, on all low-impedance, plug-in and weather proof duct. If you use duct – FPE is the only duct to use. Write for Bulletin 3-125, Federal Pacific Electric Company, Department FP-1, Newark 1, New Jersey

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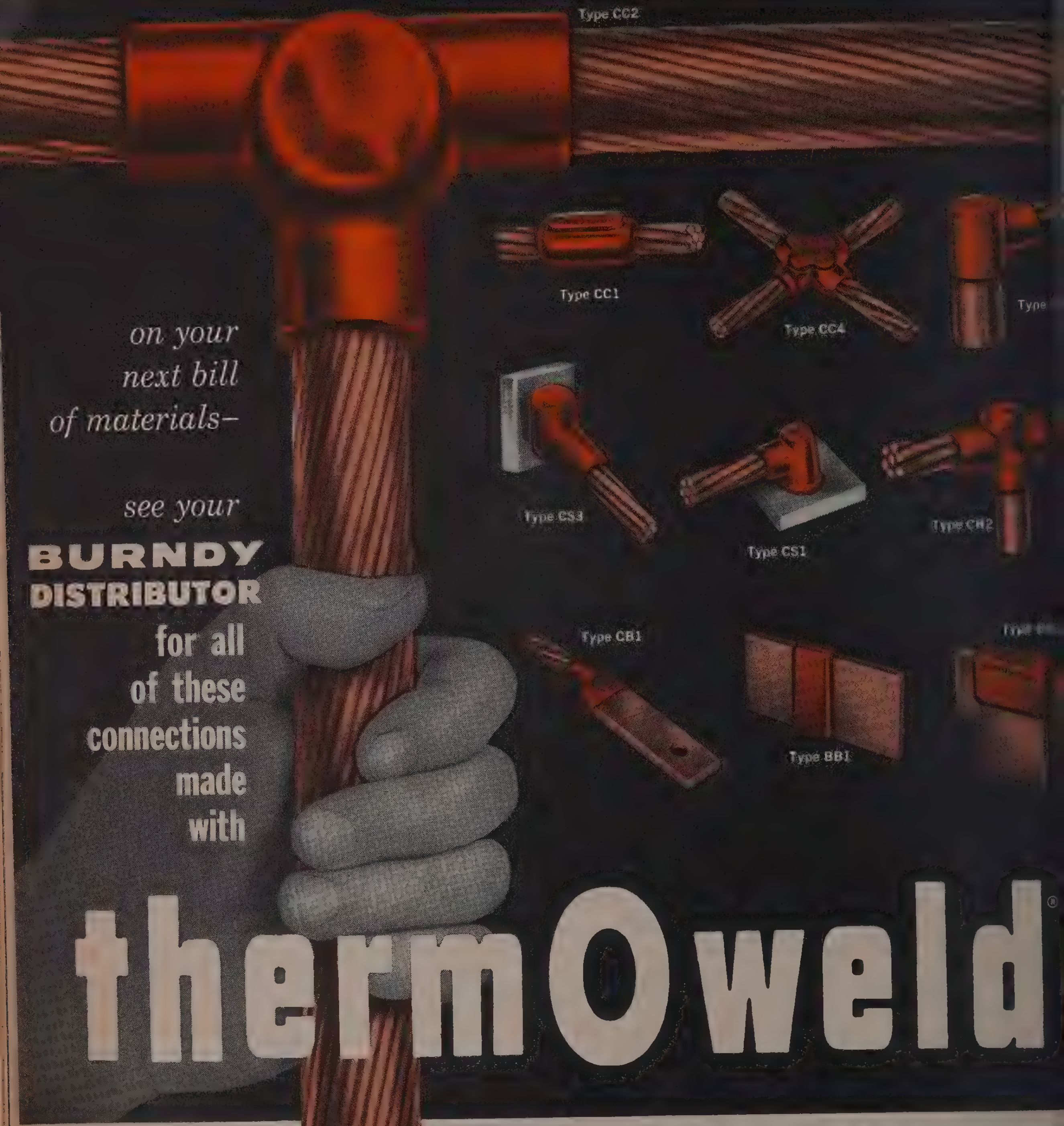


*on your next bill of materials–*

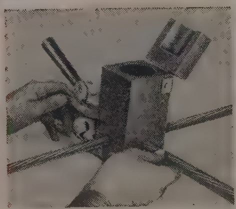
*see your*

**BURNDY DISTRIBUTOR**

**for all of these connections made with**

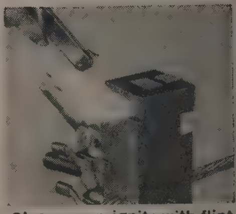
# thermOweld®

*welds a permanent electrical connection easily and economically to any copper conductor or steel structure*



Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.

Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.



Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

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ELECTRICAL
CONSTRUCTION
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# Sales Initiative

**At this time of the year** it is the custom to abandon our business, delegate our chores to others, and to escape to some remote spot for a good rest. To banish thoughts of business entirely is the best therapy. But for many a dedicated, thoughtful man, who gives most of his energy to his business life, a vacation often provides the rare chance to contemplate his industry role and to re-examine his business goal at his leisure.

**For electrical contractors,** the present times and trends invite some relaxed examination of marketing practice. Probably no single aspect of the electrical contracting business is so much in need of critical reappraisal today. The demands and needs for the expert services of electrical contractors are at record levels. The technology is advancing at an unprecedented pace. But the ways of finding business prospects, and of making sales, persist in the narrow traditional channels of past generations.

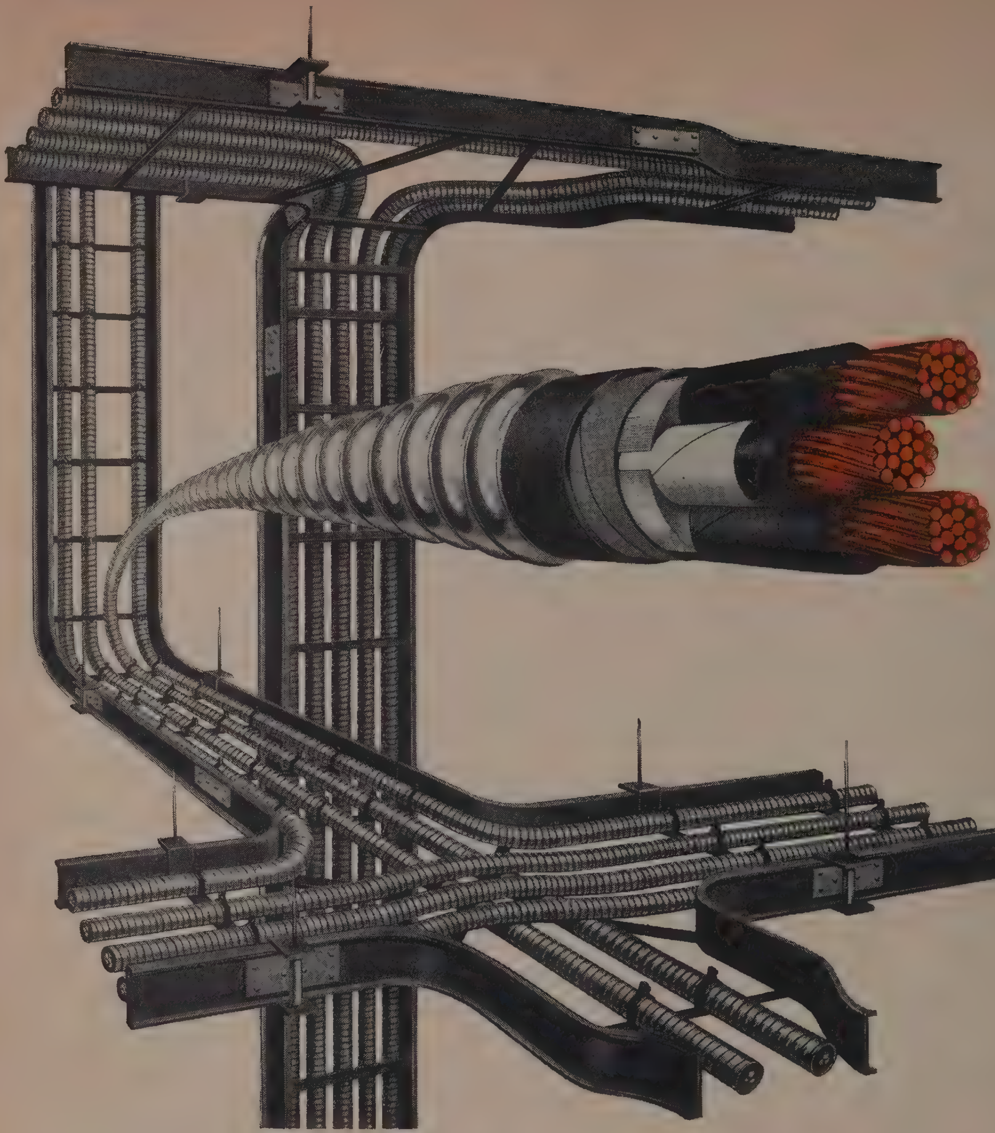
**The sales role of the electrical contractor** is not well understood in the electrical industry and often not by the contractor himself. The reason is inherent in what has been called the professional approach to marketing. In this the contractor appears to make himself available to the professionals who initiate, design and plan new construction. He is invited to submit proposals. He is selected to perform the contract. Such a passive procedure is hardly identifiable with any modern concepts of selling.

**Behind the superficial conventions,** of course, a great deal of skillful personal sales effort actually goes on. But very large areas of the market for the goods and services of electrical contractors today appear outside the framework of traditional construction industry procedures within which the contractor's sales tactics have been formed. There are many waiting prospects, dimly aware of the work they need done, who have only a vague notion of the scope of the electrical contractor's function. If the industry is to reach and to serve these customers effectively, the initiative must come from the electrical contractor.

**The task of directing a well-run electrical contracting firm** into new areas of sales opportunity is not at all formidable. The modern arts of sales promotion and the telephone have long since eliminated fruitless pavement pounding and costly personal prospecting. Expertly prepared sales aids are widely available. A nationally known manufacturer of signal equipment, for example, is currently offering a comprehensive sales kit which is a prototype and guide for almost any sales program. What is needed is not so much new skills, but the intelligent use of materials and talents already at hand.

**The big step is the initial decision to explore** the wider market opportunities now available and to reshape business practices most effectively to reach and serve them. If your vacation contemplations lead to such a decision, you may be providing your industry, your customers, and yourself with a vitally important and essentially new service.

Wm. T. Stuart



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## The First To Be Listed by Underwriters'

Phelps Dodge Armo-Lok (Type ACV) is the first varnished cloth insulated, PVC belted, galvanized armored cable rated up to and including 5,000 volts to be listed by the Underwriters' Laboratories, Inc. This cable offers a most efficient method of power distribution for industrial plants and utilities.

See your Phelps Dodge distributor for information about complete Armo-Lok Cable systems. Or write to Phelps Dodge, 300 Park Avenue, New York 22, New York.

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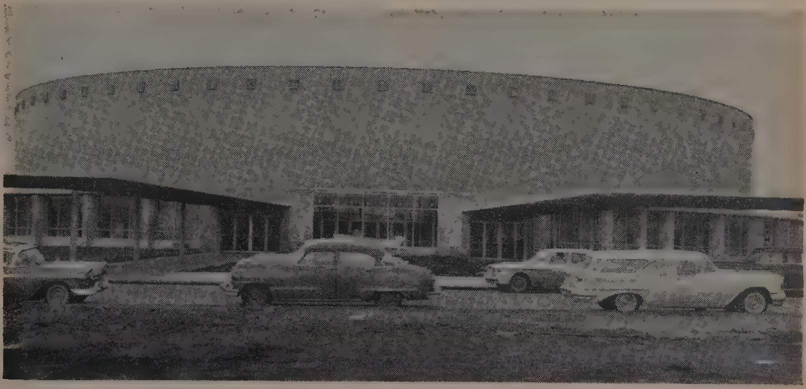


### *Utica Memorial Auditorium features a . . .*

# "Catwalk Distribution"

With an entirely new type of roof construction at Utica (N.Y.) Memorial Auditorium, engineers developed an overhead catwalk system with a practically unlimited degree of electrical system flexibility.

**By J. H. Watt**

WHEN the electrical system for the new Utica Memorial Auditorium was in the design stage, it didn't take long for the electrical engineers to realize they had hit the jackpot—electrically. What engineer doesn't dream of an electrical system that incorporates an unlimited degree of flexibility?

All this was made possible because of a patented Dual Cable Suspension-Type Roof, first of its kind in the world. This new roof construction consists of two rows of steel bridge cables, which extend horizontally from the outer circular walls of the auditorium to a small interconnecting circle, like the spokes of a huge wheel. Vertical pipe struts tie the upper and lower cable systems together. The roof of the circular auditorium rests on the upper layer of cables. And the lower cables, about 40 ft from the floor, support two circular catwalks, electrical equipment, and air-conditioning ducts.

From the floor level, one can only see the lower set of supporting cables, which are yellow in color. All other objects are painted black to form a dark background for the wheel-like supporting cables.

As a result of this unique roof construction, pillars and posts are eliminated, and up to 6500 patrons have an unobstructed view of the 24,000 sq ft arena from the seating sections.

Several accompanying photos show the variety of electrical equipment attached to the catwalk system. Equipment includes auxiliary gutters with power and lighting receptacles, 3-section panelboards, motorized dimmers for arena lighting, guard rail supports for plug-in lighting units, and sound speaker stations.

From the switchboard on the main floor, two 4-conductor, 600 MCM, Type ACV interlocked armored cables provide 208Y/120-volt supply to two 800-amp busways adjacent to the catwalks. These busways furnish power to eight 3-section panelboards, which are remotely controlled from the sound control booth.

Interlocked armored cable feeders, run in cable troughs and ladders, were selected because of slight vertical movements of the dual-roof cable system when the roof supports a heavy snow load. Feeder taps from the busway to each panelboard along the side of the catwalks also run in ACV armored cable because of the need for flexibility.

Panelboards are fastened to two horizontal angle irons, which clamp onto two vertical struts. An accompanying photo shows U-bolt connections of the angle iron to the struts. This connection method was necessary because structural engineers prohibited drilling or welding to the vertical struts for fear of weakening them.

Branch circuits and subfeeders from the catwalk panelboards supply two sets of auxiliary gutters, which extend around the periphery of the catwalks. These gutters, an upper row for lighting and lower row for power, are secured to the lower part of the catwalk guard rail. And each 5-ft section of the 6-in. by 6-in. gutter is tied together with a short length of 3-in. liquid-tight, flexible metal conduit to form the gradual curve around the circular catwalks. With this method, the contractor was able to use standard gutters, and at the same time maintain a necessary degree of flexibility.

At close intervals, flush receptacles are placed in the top of the lighting gutter. Then, after 1000-watt luminaires are clamped to the catwalk guard rail, they are plugged into the closest receptacle, and the fixture installation is complete. To provide maximum protection, a short length of safety chain comes with each fixture, and is separately clamped to the guard rail. Another added feature of this flexible lighting system is that it cuts maintenance costs, and defective units can be replaced quickly. In addition, it is a simple matter to install extra lighting units should higher footcandle intensities be required in the future. And with swivel adjustments a part of each fixture, accurate focusing of the units can be readily accomplished.

### *Temporary Power Drops*

At times the arena is used for exhibition purposes, which is the reason for the lower row of auxiliary gutters attached to the catwalk guard rail. Each gutter section contains 4-pole, 60-amp, flush power receptacles. Then, as exhibition booths are installed in the arena area, portable Type S cords are plugged into the power receptacles and lowered to the booth below.

With the use of 4-wire cords and receptacles, 120 volts, single-phase or 208 volts, 3-phase is available for the electrical requirements of any booth. Since each 60-amp receptacle is supplied by an indivdual circuit, there are few occasions that booth power requirements cannot be satisfied easily. This temporary power supply system is all the more significant because the arena floor is designed for ice hockey and skating shows, and no wiring could be installed there.

A four-sided electric scoreboard is located in the center hub of the roof-suspension cable system. Powered by an electric winch, this unit

**MILT SHATRAW,** electrical foreman for Langdon & Hughes Construction Corp., stands next to one of the eight 3-section panelboards installed along the side of the overhead catwalk system. These panelboards, remotely controlled, serve lighting and temporary power drops through a network of plug-equipped gutters, which run around the periphery of the catwalks.

**AUXILIARY GUTTERS** are mounted on the lower section of catwalk guard rails. Each 5-ft section contains receptacles for plug-in lighting units. To follow the curve of the circular catwalks, each gutter assembly is connected together with a short piece of 3-in. liquid-tight, flexible metal conduit Underneath these gutters is a row of auxiliary gutters wih 4-pole, 60-amp receptacles for connection of temporary cord drops to display booths when the arena below is used for exhibition purposes.

**LANGDON & HUGHES'** electrician is shown strapping two runs of 4-conductor, interlocked armored cable to cable ladder cross supports. These two cables supply two runs of 800-amp busway, which in turn feed lighting and power panelboards around the periphery of the catwalk.

**MOTORIZED DIMMERS** are operated by remote control from a sound control booth. Located on an overhead catwalk system, these dimmers regulate lighting intensities of overhead lighting units attached to the guard rails of the catwalks. Dimmer units are connected to panels with liquid-light, flexible metal conduit. Remote control operation of dimmers is from the sound control booth.

**PANELBOARDS AND CONDUITS** are supported to 3½-in. vertical pipe structural struts by angle iron and U-bolts. Also shown are a busway, 3-section panelboard, and cable ladder for interlocked armored cable feeders, all a part of Utica Memorial Auditorium's elaborate catwalk electrical distribution system. Careful selection and location of equipment has provided flexibility for future loads.

**PLUG-IN LIGHTING UNITS,** attached by clamps to the guard rail of a circular catwalk, provide completely flexible overhead lighting for 24,000 sq ft arena below. Lighting units plug into receptacles which are installed in the top of auxiliary gutters behind the units. Note varied adjustments of luminaries, which provide uniform lighting distribution below. Stranded bridge cables are shown below fixtures.

can be lowered during sporting events and raised out of sight during other types of performances. And for ease of maintenance, the scoreboard can be lowered to the floor level.

Incandescent-illuminated score totals are changed by remote control operation. With a four-sided scoreboard located in the exact center of a circular auditorium, all spectators have an unobstructed view of score tabulations for the sport in progress.

### *Sound System*

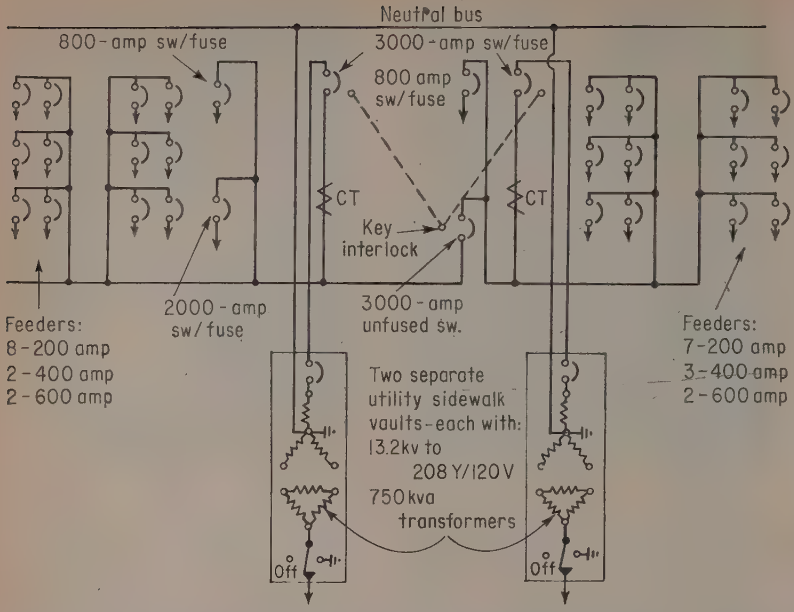
Throughout the auditorium, a paging and background music system is wired to provide stereophonic sound. And complete sound coverage is possible because of an end cluster of cellular horns plus high fidelity woofers and coaxial speakers. When a portable stage is in use at one end of the auditorium, the end cluster provides accurately-placed single-source sound. Other speakers are spread throughout the web of roof cable supports.

Output circuits to the overhead speakers are run from the control booth, located to one side of the arena above the top row seating area. Shown in an accompanying photo, the control booth contains a pedestal sound control panel with amplifiers producing 750 watts of audio power.

With this system, three different programs can be directed to different areas of the building simultaneously. And for maximum flexibility, 18 microphone circuits are available, some of which can be lowered from the overhead catwalk system to any part of the arena. Also, a telephone, intercom and paging network covers all areas of the building.

Supplying 208Y/120 volts, a 3000-amp service switchboard ties into a dual-network system. Two separate utility network vaults each contain a 750-kva transformer. And from each vault full capacity service entrance conductors run underground to two 3000-amp fused

**DATA CENTER** for air conditioning and ice making systems consists of a complete system diagram printed on a plastic face on front of the control panel, temperature and humidity indicators, and controls for making adjustments in various parts of the systems. Precise regulation of the air-conditioning system can be made from this data center for any area in the building.



**DUAL-CAPACITY** network systems supply full service capacity to two 3000-amp fused switches on the switchboard for the new Utica Memorial Auditorium. In conjunction with a 3000-amp unfused tie switch, key interlocks prevent the closing of both 3000-amp fused switches at the same time. Separate primary network feeders offered engineers an excellent opportunity to design this system. Should one primary supply fail, full service capacity can be restored quickly by transferring the load to the other network supply.

**LIGHT CONTROL PANEL,** located in sound control booth, provides remote control operation of dimmers and panelboard circuits for overhead arena lighting, which is attached to catwalk guard rails. Control circuits run from the top of the panel to contactors located at various parts of the catwalk. Engraved nameplates indicate the section of lighting each pushbutton controls and also identifies each dimmer bank control button.

**PEDESTAL SOUND CONTROL** panel supplies the source of sound control throughout the building. Located in the sound booth behind the seating area, the sound control panel is powered by amplifiers, which produce 750 watts of audio power. An end cluster of cellular horns plus high fidelity woofers and coaxial speakers are controlled from this panel. And for maximum flexibility, 18 microphone circuits are available for stations throughout the arena.

disconnects on the switchboard. A key interlock on the switchboard is so arranged as to restrict the closing of both 3000-amp switches at the same time. An accompanying drawing gives the arrangement of the dual-capacity system.

In the event of total power failure, a 50-kw generator automatically takes over and provides power to exit signs and necessary exit lighting.

With 500 tons of compressor capacity for air conditioning and ice arena requirements, the bulk of the motor load is for this equipment. At 3-phase, 208 volts, a 400 hp and a 100 hp motor operate the compressors.

In a mechanical room, a five-section data center panel contains a complete plan of the air conditioning system, printed on a plastic front of the panel. This data center houses the master controls for heating, cooling, ventilating, ice making, temperature recording, and instruments registering indoor and outdoor temperatures and humidity. With this unique system, the operating engineer can adjust the system output in any area of the building as temperature indicators show variations in any zone of the air conditioning system.

With the completion of this project, the engineers feel that they have accomplished optimum results in electrical system flexibility to handle present and future loads.

For this project, Gehren and Seltzer, New York City, were the architects, and Fred S. Dubin Associates designed the electrical and mechanical work. Sovereign Construction Co., Ltd., Fort Lee, N. J., was the general contractor with Joseph Bosco serving as the project superintendent and Paul Peckar as the project manager. Langdon & Hughes Construction Corp., Utica N. Y., was the electrical contractor.

**WIDE SELECTION** of exterior designs, floor plans and interior details results in distinctive individuality while volume construction permits inclusion of quality features at reasonable cost. This 4300-home project is largest Medallion development in the country to date.

# 4300-Home "Medallion City"

$200-million electric community in southern California offers a selection of major appliances installed, wiring capacity for future as well as present power needs, and built-in lighting indoors and out. Electrical work was by Jack Singler of Downey, Calif.

### By Hugh P. Scott

THE LARGEST all-electric residential project under construction at the present time is located in suburban Long Beach, Calif., where a 4300-home $200-million, 1200-acre community, Rossmoor, created by Ross W. Cortese, is expanding daily.

The project offers a choice of nine basic floor plans and 32 different exteriors in ranch styles, traditional or modern designs.

Electrically, home-seekers are assured of at *least* a 100-amp service entrance via No. 1 conductors, 16-breaker distribution panel, 240-volt dryer circuit complete with receptacle, all-electric kitchen with built-in range and oven, at least three additional major appliances, at least one outdoor convenience outlet, interior lighting combining beauty with functionalism, also exterior lighting consisting of fixtures outside each entrance to the house.

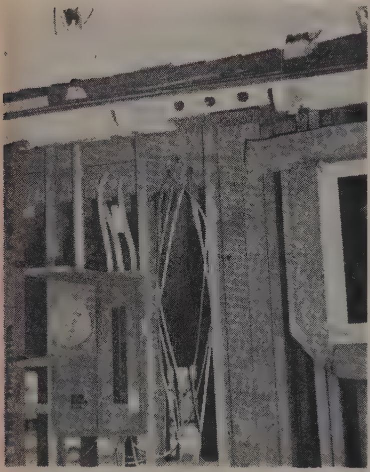
It should be emphasized, however, that these specifications are *minimum.* And, considering the tract as a huge collective unit, visitors to Rossmoor find a predominance of electric dishwashers and food waste disposers, built-in refrigerators and freezers, electronic ovens and built-in broilers, clothes washers and dryers, thermostatically-regulated resistance heating or heat pumps, air conditioning engineered for entire homes, water heaters, and exhaust fans in bathrooms and in hoods over kitchen range-tops.

Wiring conforms to the national code and local ordinances; lighting, receptacle and appliance circuits are separated; many receptacle outlets are wall-switched for convenience, while general lighting may be controlled from each entry of multi-entrance rooms.

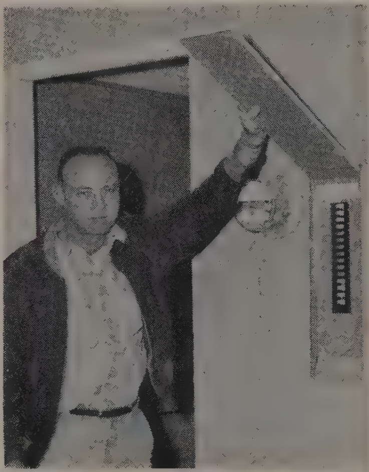
Lighting includes (1) illuminated valances, coves and cornices; (2) local illumination over kitchen sinks, cooking areas and work

**ALL-ELECTRIC KITCHENS** include built-in ranges, ovens, dishwashers, waste disposers, exhaust hoods and numerous other conveniences.

**KITCHENS SHOWN HERE** are typical of the 4000-plus contained in this community, where the promise of electrical living is proving most effective as an aid in sales-promotion.



**SERVICE ENTRANCE** is packaged assembly including mast and head, roof flashplate and raintight collar, meter pan and weatherproof distribution panel. Flexible conduits run to major appliances.



**RAINTIGHT DISTRIBUTION PANEL** serving typical home is 120/240-volt 3-wire assembly containing minimum of 16 circuit breakers. Holding hinged cover in photo above is job foreman, Ivan Foley.

**SUSPENDED REEL SPINDLE** holds cable clear of floor, revolving freely as circuit wiring is routed through predrilled framing members of this one-story residence.

**GROUND WIRES** from several metal luminaires are brought together and secured to main grounding system with use of copper sleeves, and hand crimping tool.

**ORNAMENTAL LUMINAIRE** for dining room is installed in only a few minutes by electrician specializing in this specific job category.

**DUPLEX RECEPTACLES** are wired and covers are installed quickly by journeyman who uses ratchet screwdriver to speed this repetitive installation routine.

counters; (3) vaporproof fixtures in enclosed showers; (4) lights at both sides of bathroom mirrors; (5) pinpoint downlights as well as ornamental luminaires over dining areas; (6) fixtures at tops and bottoms of stairways; also (7) ceiling lights located at least every 10 ft along halls and passageways; (8) lights in closets and accessible unfinished attic or storage areas; and (9) exterior units to illuminate gardens, patio terraces or garage thresholds.

Due to the wide selection of floor plans, plus permissible modifications and assorted features contained in homes of this large residential project, it was not feasible to adopt many "prefab" or "mass-assembly" routines. However, installation efficiency was promoted through job specialization. And, as indicated by accompanying photos, speed and proficiencies were improved by assigning journeymen to specific job categories; such as locating and securing outlet boxes, routing non-metallic-sheathed wire through wooden framing members between distribution panels and outlets, grounding metal boxes and electrical enclosures to water mains, installing receptacle plugs and switching elements, installing and grounding built-in lighting units and ornamental fixtures, plus assemblying and wiring kitchen range units and ovens, waste disposers, space-heating mediums, low-voltage signal and intercom devices, special circuiting and plug-in jacks for portable telephones, radio and TV sets.

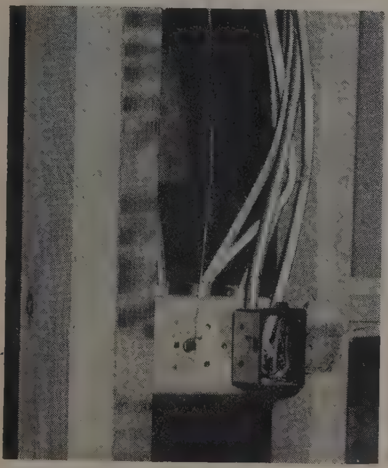
Another time-saver on this 1200-acre job-site was the use of 2-way radios between construction shacks, the main office of the development, and cars of all trade supervisors. With a trailer-mounted relay station and antenna located on a nearby hill, it was then possible to quickly locate key personnel, discuss problems, transmit directives, order essential materials and route deliveries to desired work areas.

Receiver-transmitter radios were 11-watt units left open constantly for receiving. When so used, power demanded of car batteries was in the order of 17 amps; this level jumping to 21 amps when units were used for transmitting.

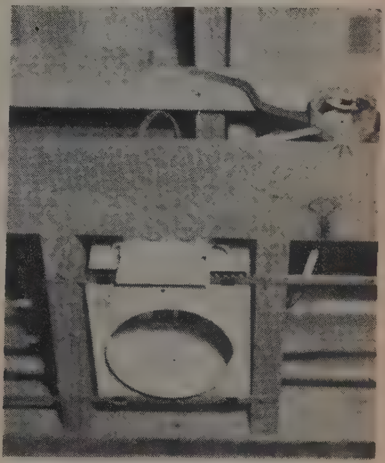
Batteries were recharged nightly to keep units at peak efficiency, while all radio equipment was checked on regular schedule by an independent electronics-maintenance company working in the area.

During initial construction stages of the various tract areas,

**WIRING EFFICIENCY** was obtained by assigning journeymen to separate job categories, although "production-line" methods were not practiced in the strictest sense.



**OUTLET BOXES** included metal units in moisture-prevalent locations, such as bathrooms and kitchens, while plastic casings were used otherwise. Note ground wire secured to metal box.



**STEPPED CONSTRUCTION** of this kitchen ceiling permits downlight to be recessed above sink while outlet box related to central luminous panel is strapped at higher level.

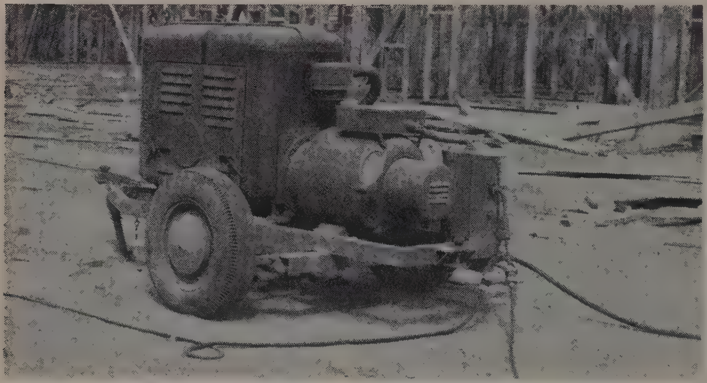
**WIRING OF DOORBELLS,** intercom systems, telephone jacks and antenna plugs for radios and TV sets was responsibility of another crew doing low-voltage work.

**KITCHEN RANGE UNITS,** built into custom-made cabinets and counter tops, were wired to control panels and checked by major-appliance specialists.

**ELECTRIC WALL OVENS** and other major appliances included in the overall cost of these homes were also installed and tested as a routine electrical job.

**JOB SUPERVISORS** on this 1200-acre project kept in contact with each other and with central offices by means of 11-watt 2-way car radios; discussing job details or ordering materials from . . .

**CONSTRUCTION SHACK,** where directives are relayed to local suppliers via telephone. Radios draw 17 amps while receiving; 21 amps while transmitting via trailer-mounted relay station.



**MOBILE GENERATORS** provided 110/220-volt power during construction periods prior to availability of utility service. Each unit, rated for 25-kw output, contained panel with four take-offs leading to . . .

**PEDESTAL-MOUNTED SUBPANEL** having 110-volt receptacles on one side; 220-volt plugs on the other.

temporary power for use by all trades was provided by a fleet of trailer-mounted gasoline-engine-generators, each one supplying 25-kw of 110/220-volt power through four twist-lock take-off plugs.

Heavy-duty rubber-sheathed 3-conductor cable carried power from these units to series of pedestal-mounted 50-amp raintight subpanels, each of which provided 110-volt current through receptacles on one side of the assembly; 220-volt power on the other side.

Subpanels were equipped with handles to facilitate easy handling, and pedestals were formed from heavy sheet steel having sides inclined to prevent trucks and other vehicles from inadvertently coming in direct contact with the elevated panels. Pedestals were also equipped with sockets to support warning and identification flags, while assemblies were grounded through No. 10 cables secured via alligator clips to earth-driven rods. Like cable connections at trailer locations, all extension cables at subpanels were secured by twist-lock plugs.

This Medallion community, having suburban advantages, yet situated only 30 minutes distant from metropolitan Los Angeles via express highways, already has attained recognition for providing home owners with a wealth of quality construction features plus liberal facilities for enjoying electrical convenience, comfort and safety. Moreover, covering as it does such a wide variety of architectural styles, floor plans and room sizes within a basic-unit price range of $19,000 to $27,000, this impressive village guarantees (1) a selection of major appliances already installed and included in the price of the home, (2) wiring of ample capacity, plenty of outlets and switches in convenient locations for efficient distribution, plus reserve power for future as well as present needs, and (3) home lighting provided through fixtures combining aesthetic values with functional placement for maximum beauty, convenience and safety.

Publicity related to this huge project is being closely related to such industry programs as Live Better Electrically, Housepower and Medallion Homes; national promotion campaigns which this year will invest over $3-million in carrying the message of Electric Living to home-owners across the nation.

The fact that such publicity is making an impression on the public is verified by the number of buyers who "ask to see the medallion" and are demanding "all electric kitchens" as a basic requisite.

Electrical contractor on this project was Jack Singler of Downey, Calif., with Ivan Foley serving as job foreman.

By **Ray Ashley**, Research and Consulting Engineer, Oak Park, Ill.

# Regular Orders Mean Lower Operating Costs, Better Earnings

## STATEMENT

A previous article (EC&M, June 1960, page 96) covered the yearly operations of two electrical contractors. Both had approximately the same $300,000 base cost (material and labor). Contractor A's annual $427,800 volume consisted of many jobs averaging about $3,000 per contract. Contractor B's annual volume of $406,100 was made up of fewer projects averaging about $10,000 per job. Because small contracts impose a heavy operating cost burden, we learned that contractor B made more money than A. This, in spite of the fact that both contractors had work of a similar nature.

## QUESTION:

***If A's contracts had come from regular customers and B's had been of the hit and miss competitive variety, would contractor B have earned more than A?***

## ANSWER:

***No. Under the above assumption, contractor A would have topped B on earnings because his operating costs for a regular flow of work would have been lower. The accompanying estimates show A earned about $15,600 more than B.***

## DISCUSSION:

Since contractor A's orders came from regular customers he enjoys the following advantages: Many of his operating costs are low. He has neither sales nor promotional expense. His estimating costs may be small (or nil). At most, one estimate per order is required whereas five or more may be required for each order received in the competitive field.

Frequently, orders come in close sequence and the resultant work from small orders can be combined into the equivalent of one large contract. A's average order was for about $3,000. For all practical purposes, the work may have been combined so the average contract would be in the $6,000 to $8,000 range.

There is no hard-and-fast rule for reducing overhead markups for regular customers. Experience indicates that the normal overhead for twice the average project size can be used. For a $3,000 order, the normal overhead for a $6,000 project would be used. Normal overhead for a $3,000 job is 20 percent. In the accompanying estimate of contractor A's cost, 18 percent (normal overhead for a $6,000 project) was applied.

The percentages mentioned are approximate averages established by cost studies for normal conditions and are offered only as a guide. Each contractor must study his individual operating costs and establish his own "normal percentages" for his specific type and class of work. To set up these percentages, one must have definite projects to which the figures can be applied. However, in most cases, it is reasonable to expect that billing for regular customers can be from 2% to 5% below that normally required.

### COMPARISON OF ESTIMATED COSTS

| | | | |
|---|---|---|---|
| **CONTRACTOR A** | | | |
| Base costs (material purchase, payroll) | | | $300,000 |
| Estimating and engineering | 2% | | 6,000 |
| Other direct job expenses (tools, supervision, etc.) | 4% | | 12,000 |
| Total job costs | | | $318,000 |
| Overhead and services | 18% | | 57,240 |
| Complete cost of installations | | | $375,240 |
| A's total sales | | $427,800 | |
| A's complete cost | | 375,240 | |
| Net Gain | | $52,560 | |
| **CONTRACTOR B** | | | |
| Base costs (material purchase, payroll) | | | $300,000 |
| Estimating and engineering | 3% | | 9,000 |
| Other direct job expenses (tools, supervision, etc.) | 4% | | 12,000 |
| Total job costs | | | $321,000 |
| Overhead and services | 15% | | 48,150 |
| Complete cost of installations | | | $369,150 |
| B's total sales | | $406,100 | |
| B's complete cost | | 369,150 | |
| Net Gain | | $36,950 | |

# How Experts Handle Aluminum

Foothill Electric Co., Oakland Calif., a Kaiser subsidiary, has had unusually extensive practical field experience as electrical contractors in the installation of aluminum conductors and raceways. Here's how experts handle aluminum electrical systems on the job.

FOOTHILL'S experience indicates that these conduit-cutting methods are satisfactory: (1) conventional hacksaw blades (18 teeth per in.) for conduit of 1 in. or less in diameter; (2) high-speed blade-type cutters for larger conduit sizes, from 2 to 4 in.

Proper coolants are important. An efficient coolant permits higher cutting speeds and produces threads of better quality, thereby minimizing wasted material and lost time. Proper coolants likewise improve the life of dies.

On a typical job, the coolant consists of a sulphur-base cutting oil (either light or dark) with sulphur in permanent suspension and (for machine operations) with a viscosity of between 130 and 150 seconds at 100 degrees F.

However, at times when this specific coolant is not available, satisfactory results are also obtained by using either machine oil cut with kerosene, or various water-soluble solutions.

For threading aluminum conduit the same type of equipment is used as for steel. Ratchet-type hand dies are used on conduits of 1¼-in. dia. or less; adjustable mechanical dies for field-threading of 1½- and 2-in. conduits where the job is not large, and machine-type threaders for larger projects and for the larger conduit sizes.

Threading machines used are of two types; those having stationary die heads (the conduit turning), and those having rotating die heads (with the conduit remaining stationary).

For normal field work, stationary die head types are found to be more efficient; permitting faster changes in size. However, where work was repetitive (that is, where many equal-diameter, equal-length conduits are being prepared on an assembly-line basis), the most effective combination is blade-type high-speed cut-off.

Both tangent dies and radial "chasers" are employed. Although tangent dies produced better threads and had ten times the life.

When properly threaded, it should be possible to join aluminum conduits by hand (except for the final few turns). Also, to prevent aluminum conduit from being marred where appearance is significant, strap wrenches, rather than steel-jaw wrenches are used.

As to bending operations, conventional hickeys are satisfactory with aluminum conduits sized 1-in. or smaller, although it was noted that EMT benders marked one size larger than the conduit produced more uniform bends; that is, when bending, ½-in. conduit, a ¾-in. EMT bender was selected, etc.

**CONTINUOUS-BAND,** motorized hacksaw having 18 teeth per inch blades was used to obtain fast, clean, right-angle cuts. This power hacksaw was used to cut larger size conduits, from 2 to 4 in.

**AUTOMATIC ROTATING-HEAD** threading machine, all-purpose high-speed (135 rpm) cut-off, and lubricant of kerosene and lard-oil proved excellent combination for obtaining high quality threads.

In cases where considerable quantities of identical-degree ell bends or 90-degree stubs were required (such as for typical floors), the mass-production pre-bending methods involve the use of both hand-operated and motor-driven mechanical units. And, in bending larger sizes, hydraulic one-shot benders are used to obtain accurate, fast results.

To bring the bending shoe up against the conduit quickly, fast-approach cylinders for benders are included. This fast-approach speed is used effectively to bend conduit up to 2 in.

Use of lightweight hydraulic bending devices had several advantages for, (1) when working with 3- to 3½-in. conduit, bending time is reduced by 50%, (2) lightweight units can be carried up ladders and assembled on overhead runs to bend conduit to exact angles in place, and (3) by field-bending standard-length conduit rather than using numerous standard elbows of various radii and degrees to obtain the same purpose, the number of joints was greatly reduced; cutting and threading was likewise lessened. In general, motorized benders are used when larger conduit sizes are bent prior to installation, while hand-pump hydraulic-plunger types are used when offsets are to be made after conduits have been initially positioned on overhead racks.

Portable bending stands fabricated from angle-iron and equipped with hickeys positioned in the vertical plane are also used to advantage. With the bending point raised some 18 in. above the floor, it became unnecessary for workers to bend too far down. Moreover, since the bending plane is vertical, manual pressure can be exerted directly downward, thereby maintaining a firm, unshifting support.

The practices described are those specifically reported by Foothill Electric job management personnel as currently used and job-tested by this company. It is not intended to imply that these are the only feasible techniques which may be employed. Other methods than those described may be equally practical and effective.

In the new Kaiser building in Oakland, conduits were buried in slabs without any auxiliary coatings; although, in several instances where feeders were buried directly in *soil* beneath basement slabs, additional protection was provided by wrapping conduit with polyethylene tape. Where such installations involved buried joints, boxes or connections, protective continuity was maintained by painting with neoprene- or bituminous-type paints.

Due to the fact that polyethylene can be damaged fairly easily (by vise jaws, pipe wrenches, etc.), considerable care was exercised in handling and placing wrapped conduit. The completed installation was thoroughly inspected prior to covering, and any damaged spots were promptly repaired by additional application of tape.

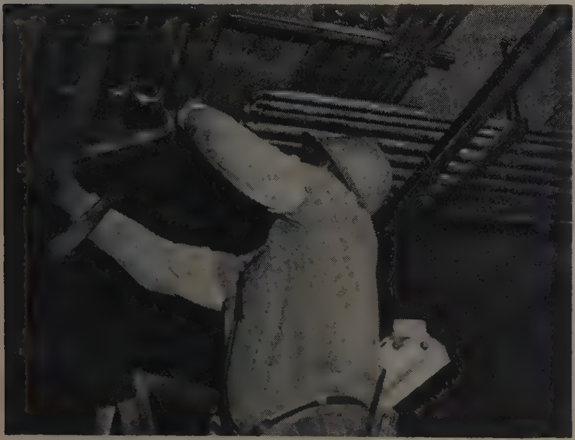
Rough handling and physical abuse of the conduit was avoided at all times. Also, to prevent unnecessary stresses prior to the actual pouring of concrete, conduits were supported and secured by a variety of props, metal straps and stubs as soon as they were initially installed.

### *Installation of Wire and Cable*

Foothill's work at Kaiser Center represented practical experience accumulated during the previous wiring of seven major aluminum-system plants. Considerable attention was given to tested techniques related to wire and cable pulling, splicing and connecting. Compression splices have proved to be completely reliable. They are easily applied with appropriate tools, and they provide simple surfaces to insulate and tape *provided* the right size connector, the right size die and an oxide inhibitor are used together.

A cause of potential trouble (too large a die) results in insufficient compression and contact area, while another cause of failure (forgetting the oxide inhibitor) can be overcome by purchasing lugs having a self-contained inhibitor.

On this specific job, use of circumferential dies having compression areas of 360 degrees resulted in maximum conductor-to-lug contact and, upon observing such connections closely, it was noted that single wires of conductors were somewhat reduced in diameter and distorted; a highly desirable condition since this resulted in breakup of the oxide film surrounding the various strands.



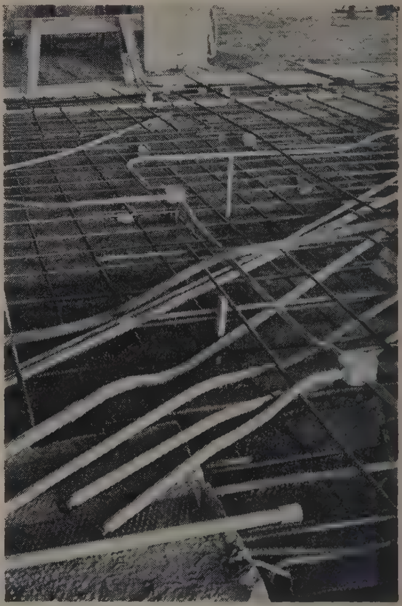
**EXCEPT FOR LAST FEW TURNS,** these conduits were screwed into couplings by hand; a strap-wrench then being used to snug the tapered, threaded ends into the collars to establish positive electrical continuity.

**FAST, ACCURATE BENDS** of large-diameter conduits were obtained with the use of one-shot motor-driven mechanical plunger units. Hand-operated plunger units were also used when conduit was to be bent in place.

**MASSED CONDUITS** at this point indicate how the field-bending of standard lengths can reduce the number of factory ells of varying sizes. This likewise reduced the number of joints, cuts, threads and reaming operations.

**MANUAL BENDER** with fulcrum raised 1½ ft above the floor permits worker to exert pressure without undue back fatigue. And, since the bending force is applied in a vertical plane, the rig has no tendency to slide or shift.

**POLYETHYLENE TAPE** was wrapped around conduit in spiralling over-lapping pattern when aluminum raceways were laid in earth beneath basement slabs. After completion of underground installation, tape insulation was inspected for abrasion breaks, and any scratches were then covered by additional tape.



**PRIOR TO POURING** of concrete slabs, conduits were propped up, supported and secured by metal stubs, bricks, straps, small concrete blocks and similar mediums in order to prevent subsequent settling or stress. During installation, ends of conduits were kept capped (as noted in foreground) to prevent entrance of moisture, dirt and debris.

Tools employed in making these compression joints were small and compact; hand tools being used to compress terminals related to No. 8 wire or smaller, and hydraulic tools being used for all larger sizes on the job.

Some switches, switchboards and circuit breakers come equipped with mechanical copper terminals that could not be removed. One aluminum-to-copper procedure was to insert small lengths of copper cable or wire in these terminals, then make splices to the aluminum feeders by means of compression-type aluminum two-way connectors.

Where aluminum lugs were bolted directly to steel or copper studs, Belleville washers were also inserted between flat washers and nuts to provide this same compensating factor; applying sufficient pressure to compress washer domes.

In making branch-wire eye-loop connections at distribution and control panelboards, the practice was to (1) strip insulation from conductors by the pare-off or "penciling" method, rather than by the sharp "ring" method that might nick the conductor, (2) abrading the conductor surface with either emery paper or with a fibre-glass brush, (3) applying a connector aid containing a sealing paste, then (4) laying the eye loop in the same direction that the screw is tightened.

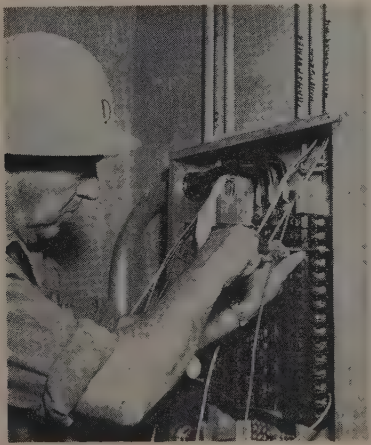
In cases where small-size conductors were spliced together by pigtail connectors, insulated coiled-spring types were used; small amounts of anti-corrosion and sealing compound were squeezed into connector caps to insure positive joints.

For fishing purposes, super-flex-

**NO SPRING BACK** is found in aluminum conduits. In working with small-diameter conduit, using bender marked one size larger than conduit will prevent binding and improve uniformity of results.

**DIRECT BURIAL** in concrete required no additional protective coverings. In making up joints in long conduit runs, an anti-seize compound consisting of heavy grease and lubricating graphite was used.

**INSULATION WAS STRIPPED** from thermoplastic-covered branch-circuit wires by paring-off jackets by the "pencilling" or taper method, rather than by the "ring" method which might result in conductors being knicked by the cutting blade.



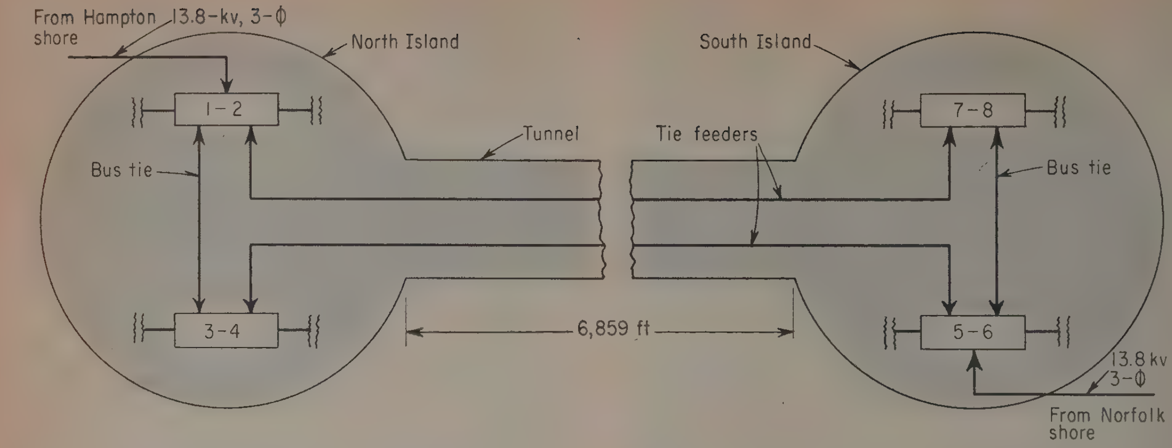
**PANELBOARD CONNECTIONS** were established by first abrading stripped conductor ends with a fibre-glass brush or emery paper; laying-in "eye loops" clockwise; applying small amounts of sealing paste containing a corrosion inhibitor, then snugging down the screws.

**STRIPPED CABLE ENDS** were slightly staggered to create a leading section having greater flexibility; particularly desirable when cables were to be pulled around bends. Cable slack was left in all junction and pull boxes to minimize tension.

ible tapes (some nylon-jacketed) proved most satisfactory, while excellent results were also obtained by using gun-type devices to propel nylon pulling lines through long conduit runs.

Due to the fact that aluminum is softer than steel, care was used in running steel fishwires or tapes through conduits containing bends, because tough pulling conditions could result in the harder metal cutting the inner sides of bends and elbows. This tendency proved negligible when fishwire was spirally wound or had an end-ball.

**STEEL FISHWIRES** and tapes, especially on conduit runs containing bends, were used with care, to prevent the harder metal scratching or cutting into interior surfaces of the softer aluminum. Precautions included installation of bushings at conduit ends, pulling conductors as straight-out as possible, using fishwires equipped with end-balls, also gun-type propelling devices and nylon pulling lines.



**ELECTRIC POWER** for Hampton Roads Bridge-Tunnel is supplied from two sources, from Hampton shore to North Island, and from Norfolk shore to South Island. Two separate 3-phase, 13.8-kv submarine cables transmit the power from each shore to its closest island. Four 2000-kva double-ended power center substations each contain two 1000-kva transformers which reduce voltage to 480/277 volts, 3-phase wye, grounded neutral (designated 1-2, 3-4, 5-6 and 7-8 in illustration). These are then interconnected by bus ties and tie feeders, to provide complete continuity and reliability of service.

# *Service Continuity Assured by* Electrical System

Separate power sources insure electrical service continuity and system reliability, providing proper tunnel ventilation and good lighting, for the new Hampton Roads Bridge-Tunnel, which connects Norfolk, Va., with the Newport News—Hampton area.

THE new Hampton Roads Bridge Tunnel is the first direct physical connection across Hampton Roads, Va.; a "dry" route between the Newport News—Hampton area, and the Norfolk area. It crosses historic Hampton Roads near the site of the famous battle between the "Monitor" and the "Merrimac," and passes near Old Point Comfort and Fort Monroe. It replaces two ferry routes and has cut the crossing time from 30 minutes or longer to about five minutes.

The facility actually consists of two low-level bridges, plus one underwater tunnel between man-made islands. The two islands were built up from material dredged from the bottom of Hampton Roads itself. The North approach bridge consists of 65 50-ft spans supported on prestressed concrete piles, a length of 3,250 ft. The tunnel consists of 23 prefabricated steel tubes, each 37 ft in diameter and about 300 ft long, actual total length 6,859 ft. The South approach bridge consists of 123 50-ft spans covering a length of 6,150 ft. The total length, including island roadways, is 18,364 ft or 3.478 miles.

The Hampton Roads Bridge-Tunnel System, which includes the Bridge-Tunnel plus about 20 miles of access roads, was built and is operated by the Virginia Department of Highways. The tunnel is the first ever constructed with its portals emerging on man-made islands, and the first vehicular tunnel to utilize adjustable-pitch blades remotely controlled on vane-axial fans for regulating air in quantities in the ventilating system.

The electric power requirements of the bridge-tunnel can be divided into three primary categories: (1) power and control for tunnel ventilation with air supply and exhaust both from each end of tunnel; (2) power and control for lighting of both bridges, tunnel, islands and buildings; (3) power and control for miscellaneous equipment such as fire pumps, drain pumps, flood gates, traffic lights, alarm systems, garages, and carbon monoxide analyzers and recorders. Some of each kind of equipment is located in the ventilation building built on both islands immediately over the cut-and-cover portion of the tunnel adjacent to the portals.

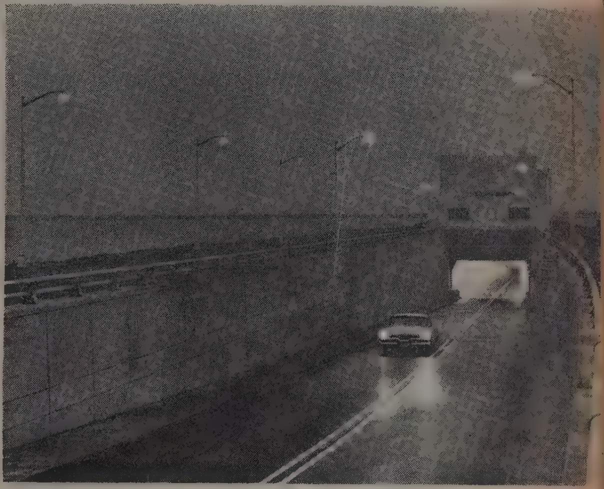
The sources of electric power were located on the mainland at

**APPROACH** to tunnel is by means of two low-level bridges, one at each end of tunnel, consisting of 50-ft spans supported on prestressed concrete piles. Daylight view shows mercury luminaires and standards.

**MERCURY** luminaires using 400-watt lamps light the bridge approaches. Uniform lighting is provided for the two-lane approach by staggering the units on each side of the roadway, as shown in this night view.

# Reliability

**By H. A. Albers,** *Vice President*
*E. C. Ernst, Inc., Washington, D. C.*
*and*
**W. G. Phillips,** *Service Engineer*
*Westinghouse Electric Corp., Newport News, Va.*



**TUNNEL** is entered from bridge, which is graded for the tunnel's lower level. This general view shows mercury approach lighting on the bridge, and fluorescent lighting in the tunnel.

the shore end of each approach bridge. Since separate power sources were required at each of the portal islands, a single armored, sectored 3-phase 13.8-kv submarine cable was used to transmit power from each shore to its closest portal island. At each island this submarine cable terminates in the high-voltage switchgear of two of the total of four 2000-kva double-ended power centers.

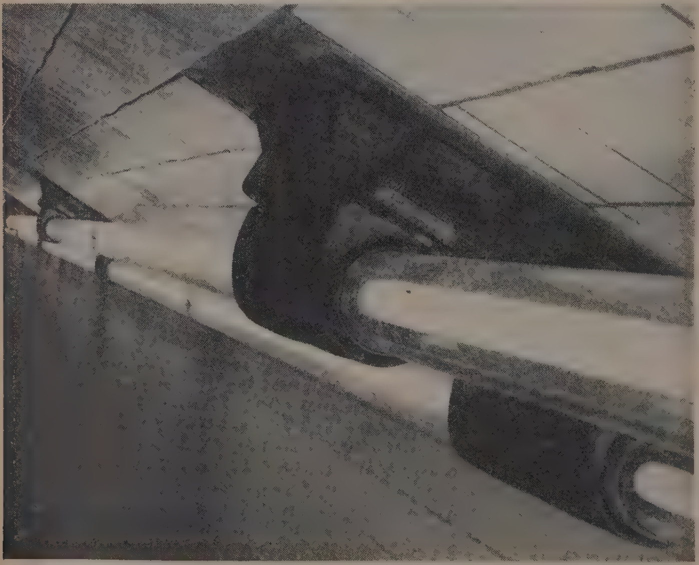
The high voltage electrical equipment consists of four 2000-kva double-ended power center substations, two located in each of the ventilation buildings on each island. Each substation consists of double-ended sections of 13.8-kv indoor metalclad switchgear, throat connected to two 1000-kva Inerteen-immersed transformers that reduce the voltage from 13,800 volts to 480/277 volts, 3-phase wye grounded neutral. These substations have been designated as 1-2 and 3-4 on North Island and 5-6 and 7-8 on South Island. They are interconnected by high-voltage bus ties and high-voltage tie feeders through the tunnel. The single line diagram shows how this interconnecting allows any substation to be fed from either shore station. Each incoming line, bus tie, tie feeder and transformer primary feeder are controlled by 13.8-kv drawout air circuit breakers rated for 250,000 kva interrupting. All high-voltage breakers are identical and interchangeable for any location, and their control is interlocked so that it is not possible to feed any substation from more than one source at a time.

The low voltage equipment includes 480-volt indoor metalclad switchgear, throat connected to each 1000-kva transformer. This low-voltage switchgear includes transformer secondary circuit breakers, low-voltage bus tie circuit breakers or connections, on four units feeder breakers for fire pumps, and on two units tie breakers for connection of emergency diesel generators. All these low-voltage breakers are drawout air circuit breakers of only two different sizes, with the same size interchangeable to any location. The eight transformers are designated as Nos. 1 to 8 inclusive, as is the associated LV switchgear. The LV switchgears are interconnected by bus ties across each of the four main power centers; thus each LV

**LIGHTING** in tunnel portal consists of two continuous-row two-lamp luminaires, one on each tunnel wall near junction of wall and ceiling. Comparison of lighting in tunnel portal and daylight outside the tunnel is shown in this view.

bus can be fed from either of two transformers.

First of the three primary uses of the electric power is ventilation. There are a total of 16 ventilating fans (8 supply and 8 exhaust), each being a vane-axial type fan driven by individual 480-volt, 2-speed, 2-winding induction motors. Eight fans are for supplying fresh air into an air duct below the tunnel roadway; these are rated at 35 hp low speed and 300 hp high speed. The other eight fans are for exhausting vitiated air from a duct above the tunnel suspended ceiling—these are rated at 50 hp low speed and 400 hp high speed. In addition, each fan has three other small motors associated with it; (1) 2-speed auxiliary cooling fan to provide proper cooling air for the main fan motor; (2) a reversing motor that drives the blade pitch changing mechanism of each fan; and (3) a reversing motor that drives dampers that shut off each fan from the air ducts when not in use.



**LUMINAIRES** consist of cast bronze socket bodies, Pyrex protective tubes and fluorescent lamps. The luminaires are double-row units for the last few hundred feet at each tunnel portal, and single-row units along each side of tunnel in the tunnel proper. Each row in the double-row units is controlled separately, and both rows lighted during daylight hours, only one row lighted at night.

The 16 fans are divided so that there are four supply and four exhaust units in each vent building on each island. The control for each vent fan motor plus its associated auxiliaries, protection, and alarms are consolidated into 16 special built motor starter units. These motor starters are built in consolidated switchgear-type units and are located two-in-line close coupled to each LV switchgear unit.

The second and third primary uses of power consists of eight 480-volt control center type switchgear units located in unitized construction units, close-coupled to the ends of the vent motor starters on each transformer LV switchgear. These control centers include fused primary disconnect switches for numerous sections of bridge and tunnel lighting together with the necessary clocks, timers, and contactors for the automatic lighting control.

### *Master Control Board*

Located in a separate room on the second floor of the north vent building is the master control board, from which location all the normal operation of the entire bridge tunnel is controlled. It consists of a free standing switchboard on which are located all the necessary switches, pushbuttons, and indicating lights for complete control of all electrical operations. Mounted on the surface of this master control board is a "Mimic Bus" that shows diagrammatically the entire high-voltage system, the eight transformers, and the low-voltage bus systems. Interspersed into this "Mimic Bus" system are the actual control switches and indicating lights for all the high- and low-voltage air circuit breakers, and meters for incoming line voltages and transformers primary load currents. This indication and control section is actually physically divided into two sections, the same as the equipment itself, left end of board for North Island and right end for South Island and shows in part through-tunnel feeders.

The center portion of the master control board is primarily devoted to tunnel ventilation, with a secondary use for indication and control of drain and fire pumps.

In case of loss of power from both shore stations at the same time, or some other emergency, there are two 125-kva, 480-volt emergency diesel generators, one located in each vent building. The diesels must be started manually, either from the engine or from the master control board, but after starting, the generators automatically set up the proper circuits when the correct frequency and voltages are available. Then the operator can manually close one breaker and supply emergency power for necessary lighting, drain pumps, fire pumps, and some ventilation.

As a separate system, apart from the emergency power, is the necessary control power. All the high- and low-voltage air circuit breakers control a part of each vent fan control, the alarm system, and the sequencing of the automatic drain pumps employing 125-volt dc power. This control power is supplied from two separate 125-volt dc batteries, one in each vent building, that are kept full and charged with automatic battery chargers.

### *Lighting*

The lighting for the bridge-tunnel can be divided into three sections; bridges, tunnel, and islands and buildings. Each section uses a different type of lighting that requires different special voltages and controls. However, for ease of operation, installation and maintenance all power and control transformers, special reactors, capacitors, contactors, and controls are consolidated in one separate room in each vent building on each island. These lighting transformer rooms are located on the second-floor of each vent building, and the entire room is arranged for automatic forced ventilaton to keep the ambient temperature within specified limits.

The bridge lighting employs Type OV-20 short-arc mercury luminaires supported over the roadway from aluminum poles. They are evenly spaced on alternate sides of each bridge in order to provide a uniform lighting level.

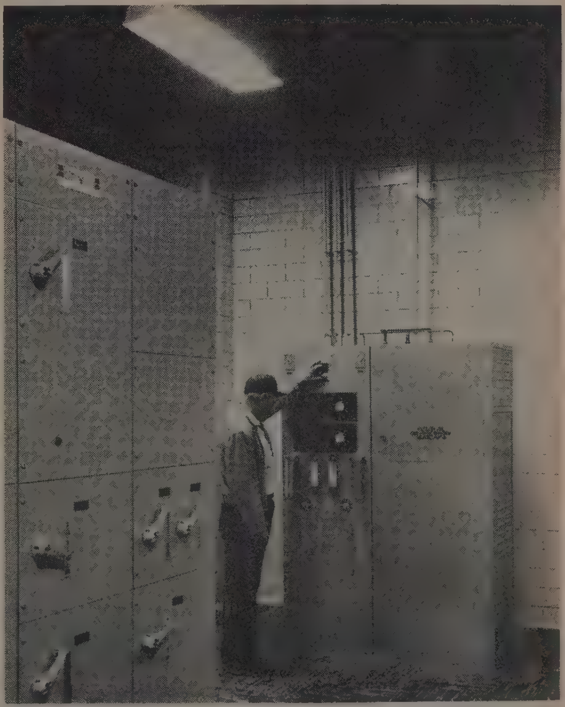
The islands employ standard incandescent street lighting of the constant current type, while the vent building and garages use standard fluorescent or incandescent units.

The lighting for the tunnel itself is continuous-line fluorescent luminaires that extend all the way through the tunnel on both sides. The fluorescent tubes are enclosed in Pyrex glass envelopes, and mounted in special bronze fixtures inset into the tunnel walls. The entire tunnel lighting system is waterproof, so that the tunnel can be cleaned with a water spray without damaging any of the lighting. The luminaires are arranged in a single row along each side of the tunnel, with a double row on each side for the last few hundred feet at each portal. These double rows are separately controlled so that two rows are used in the daytime, but only one row at night. This minimizes the contrast in light intensity between the tunnel and the outside light.

An additional novel feature of this portal lighting—in addition to the use of one or two rows of lights—is a variation in the intensity of light from whatever rows of fluorescent tubes are in use. This is accomplished by inserting varying amounts of special reactors in series with sections of the fluorescent tubes, thus varying the light output to also minimize the change from tunnel light to outside light.

Other than the electrical installation in the tunnel proper, the installation of the electrical materials in the ventilation buildings, on the island and on the bridges was, in

**MAIN POWER CENTER,** one of four shown here, each consists of two 1000-kva transformers, and double-ended sections of 13.8-kv indoor meatlclad switchgear. The draw-out features of control relays are being demonstrated here.



**SAMPLES** of tunnel air at four different locations are analyzed for carbon monoxide content by this equipment, and transmitted to recorders on master control board on floor above. Controls on left are at end of main power center.

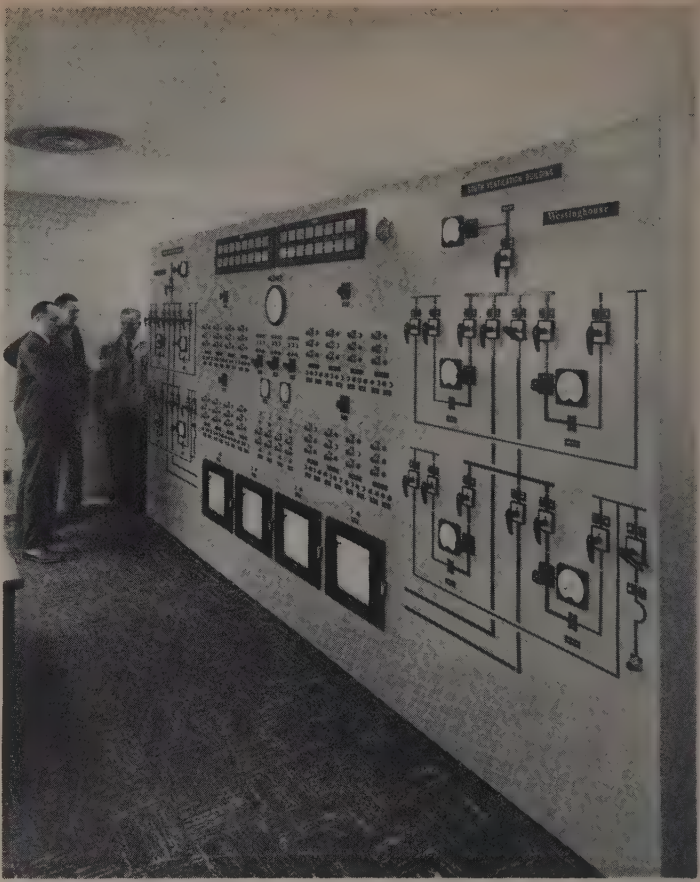
the main, commonplace and presented no particular problems. However, one unique feature of the lighting installation on the bridges should be mentioned. This was the use of the top run of the aluminum handrail which was installed on either side of the bridge as a raceway for the conductors feeding the bridge lighting standards. Special cast aluminum boxes mounted along this rail provided both an enclosure for the mercury fixture ballasts as well as a base for supporting the aluminum poles. A line truck equipped with a hydraulic boom provided a convenient method of mounting the poles after they had been completely fitted with arms, luminaires and internal wiring.

### *Conduit Wiring in Tubes*

The tubes, which consisted primarily of a steel shell with a reinforced concrete lining both inside and out, were fabricated at the Baldwin-Lima-Hamilton Co. yards at Eddystone, Pa. Movement of the tubes from the shipyard to the jobsite was accomplished by a natural water route, each tube being shepherded by several tugboats. Accordingly, the primary installation of the electrical conduits and fixture backboxes was therefore made in the shipyard while the tubes were being fabricated.

As the tubes were sunk and attached one to the other, the bulkheads were removed at two-week intervals. However, in order to speed the completion of the overall project, the electrical work had to proceed during this period. While gasoline powered equipment was used throughout the construction due to the foresight of installing temporary ventilating fans and shafts, the problem of traffic congestion was considerable in view of the fact that while tube bulkheads remained in place, there was only one entrance to the tunnel. It was virtually impossible to turn around any vehicle larger than a normal farm tractor. The fact is that just such a tractor, equipped with a winch on its power take-off, and supplemented with several 4-wheel trailers, provided the means of moving the major portion of the electrical materials into the tunnel, as well as pulling both power and control cables.

It should be noted that at no time during the entire electrical installation was water a problem. The tubes remained dry and several times sprinkler trucks were used to reduce dust.



**MASTER CONTROL BOARD,** located in North Vent building, is shown here. The "Mimic Bus" at each end of the board shows the entire high-voltage system, the light transformers, and the low-voltage bus systems, including actual control switches, and meters. Left end of the board shows equipment for North Island, and right end of board shows equipment for South Island. The through-tunnel tie feeders are shown at bottom.

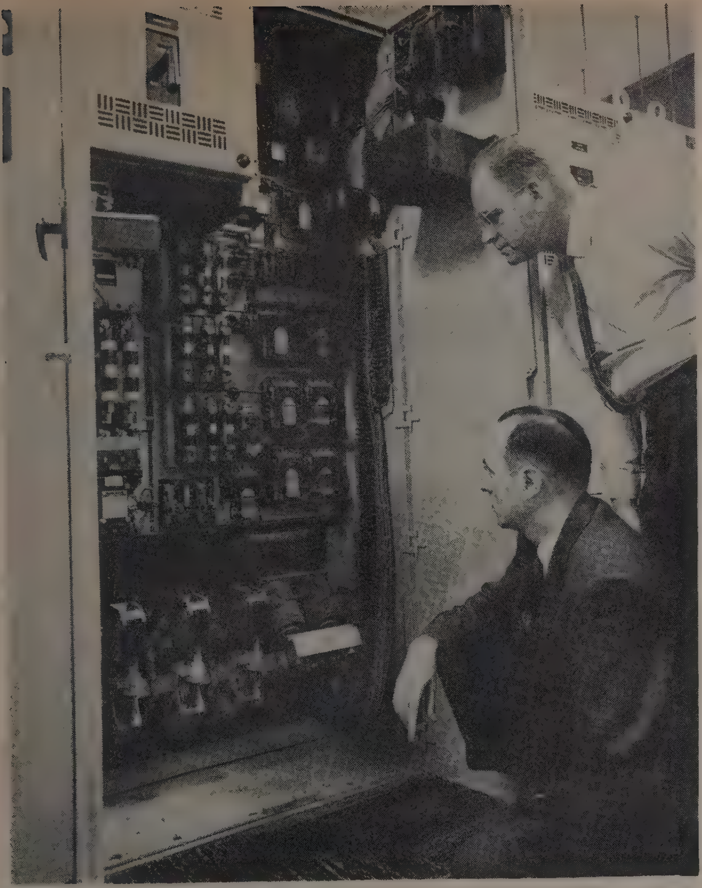
Following the pulling of the cables, the main concern was the installation of the tunnel fluorescent luminaires. These fixtures consisted basically of a bronze housing for ballasts and sockets spaced 12 ft 7 in. on center, between which two 6-ft fluorescent lamps were to be installed in series, after first being fitted into the 2½-in. diameter Pyrex tube. The problem here was one of dimensional variations in the spacing of the fixture housings and was solved by each socket being mounted on a coil spring which allowed for a variation of plus 3 in. and minus 1 in.

### *Features of the System*

The complete electrical system for the 3.478 miles of bridge and tunnel was furnished and installed for a cost of about $1,650,000.

A major feature of the electrical system is reliability and continuity of service. It is assured by the use of two separate power sources, and the proper number and location of bus ties and tie feeders. Proper switching operations alone will permit any device—fan, pump, or light—to get its power from either of two transformers fed from either of two primary power supplies. The installed capacity of the various cables, transformers, tie feeders, and buses is such as to allow normal operation of the bridge tunnel with only one of the primary power sources in use. Also normal bridge tunnel operation is possible with up to four of the eight main transformers out of service by the proper use of the low voltage bus ties.

Incorporated into the control scheme for all the air circuit breakers are individual phase overcurrent relays that afford protection



**INTERIOR** of fan control cubicles reveals the fan main circuit breaker and two-speed controls, also the fan blade pitch control equipment, remotely operated from the master control board. These cubicles are part of the main power centers.

for the various devices beyond any breaker, and also quickly isolate any fault within the interrupting capacity of any breaker, and can cascade on back to the main incoming power breaker, if necessary.

### *Tunnel Ventilation*

A prime requirement of any vehicular tunnel is reliable ventilation under all operating conditions. Installed fan capacity is based on emergency conditions such as a gasoline or other type of fire. Normal tunnel operation is possible with less than half of the number of installed fans in use at any time. Thus about half of the fan motors and controls are not required for normal use, but can be maintained as standby units for emergency use. A regular system of rotation of the fan units in use assures an even use factor for all fans, yet allows sufficient time for necessary servicing and maintenance, and the correction of any troubles that might show up, without interrupting the required tunnel ventilation at any time.

### *Maintenance and Operation*

Ease of operation and maintenance was also of prime importance in the selection of the electrical system. Operation is made easy by the grouping of all switchgear, transformers, and control centers in only two locations—one on each island—and at each location everything in the same room. The master control board is the major factor in ease of operation—all normal operation is controlled from one spot.

These same factors also lead to better and easier maintenance and repair. All the switchgear—high voltage, low voltage and control center—is of the dead-front-type construction with mechanical interlock devices that automatically trip the breakers when the door is opened. All of the air circuit breakers are of the horizontal drawout type, and are interchangeable with any other of the same size and type if continuity of service is necessary during maintenance or repair on any given circuit.

All the high- and low-voltage air circuit breakers have three possible positions in each switchgear cell—in operation, test position, and

(Continued on page 128)

**CONTROL CENTER CUBICLE** contains control and timers for the exterior bridge and portal lighting equipment.

### Anatomy of

# Design Heat Losses And Annual Energy Requirements

A breakdown of metered annual heating energy for heavily insulated houses into component heat losses and heat gains.

**By Glydewell Burdick,** *Wisconsin Power & Light Co., Madison, Wis.*

*The Electric Heating Forum, beginning in this issue, is devoted to discussions of electric space heating practices and problems. This month the question of annual energy requirements, still of major importance to supplier, installer, and user alike, is analyzed by Glydewell Burdick, using as a yardstick the metered results of installations in heavily insulated houses as reported in our April issue*[1]*. Mr. Burdick suggests that a curve relating NEMA constants to design heat loss may be helpful. Obligingly, Howard S. Smith and Floyd Olson have done just that in the article following.*

*Readers are invited to express their opinions; relate their own experience data to the material presented; or submit new ideas, research data, or case studies on any aspect of electric space heating. Please address correspondence to:*

Electric Heating Forum
Electrical Construction and Maintenance
330 W. 42nd Street
New York 36, N. Y.

ATTEMPTS to reconcile known low annual energy requirements for electric heating of homes with long-established heat-loss factors for building materials have been given a valuable benchmark by the efforts of Floyd Olson and his associates in the Salt Lake City area[1].

The principal aims of such efforts are (1) to uncover those factors affecting annual energy usage which appear to be poorly handled in both the NEMA and FHA energy estimating formulas[2], and (2) to show the areas of greatest seasonal heat loss, where efforts toward reduction would promise to have a material effect in reducing the annual cost of electric heating.

Olson's heating energy requirement of 0.9 kwhr/sq ft of floor area per 1000 degree-days for heavily insulated homes (10-5½-9½), proved by many full-year submetering records and demonstrated in detail by reference to eight specific homes, indicates that the estimate of 1.1 kwhr/ sq ft (or 9600 kwhr/year) I made a year ago[3] for a 12-6-6 home is too high.

An extension of the results of Olson's 8 homes to different climates gives the following energy usage (based on a 1200-sq-ft floor area):

| *Degree-Days* | *Kwhr* |
|---|---|
| 4000 | 4320 |
| 6000 | 6482 |
| 8000 | 8640 |

Interpolation shows that, for the 7200-degree-day-area used as a basis of calculations for my 12-6-6 home, the annual requirement would be 7776 kwhr—other things being equal.

# Design Heat Losses and Annual Heating Energy for an Electrically Heated, Heavily Insulated Residence

Design temperatures: —15F outdoor; 70F indoor; TD= 85°
Degree-days: 7200 on 65F base; 8230 on 70F base
Floor area: 1200 sq ft
Type of heating: In-space resistance heaters.
(Numbers in parentheses are references to notes.)

| Source of Heat Loss | Area (sq ft) | Design heat loss (Btu/hr) | | Annual Energy Requirement (kwhr) |
|---|---|---|---|---|
| | | Design (1) | Adjusted (2) | |
| Ceiling | 1200 | 2162 | 1890 | 1287 (7) |
| Walls (net) | 854 | 2904 | 2740 | 1866 (7) |
| Windows | 224 | 7997 | 7530 | 5127 (7) |
| Doors | 42 | 1142 | 1075 | 732 (7) |
| Floor | 1200 | 1432 | 1432 (3) | 1699 (3) |
| Fresh air | 80 cfm | 7344 | 5508 | 3750 (7) |
| Total | | 22981 | 20175 (5) | 14461 |
| Total per sq ft | | 19.1 | 16.8 | ........ |
| Total per sq ft adjusted to 70° TD | | 15.7 (6) | 13.8 (6) | ........ |

| | | |
|---|---|---|
| Estimated gross heating energy requirement......... | | 14461 kwhr (7) |
| Contributions to gross requirements from sources other than the heating equipment: | | |
| Body heat from occupants........... | 1044 (8) | |
| Misc. use of electricity | | |
| Water heating.................. | 1170 (9) | |
| Other......................... | 2400 (10) | |
| Subtotal, interior gains............. | 4614 | |
| Effects of solar radiation received | | |
| Heat received directly through windows........................ | ? | |
| Reductions in heat losses by raising exposure temperatures of walls and ceiling.................. | ? | |
| Subtotal, solar gains............... | 3421 (11) | |
| Total heat gains....................... | 8035 | |
| Less latent heat loss in exfiltration air...... | 1350 (12) | |
| Net heat gains from miscellaneous heat sources........................... | 6685 | 6685 |
| Net annual heating energy requirement............. | | 7776 kwhr (13) |
| (This is the energy that would be measured by a submeter on the electric heating equipment only.) | | |
| Heat factor, kwhr per sq ft per 1000 degree-days.... | | 0.9 |

Notes to table:

(1) Design factors are based upon the design condition, including a 15-mph wind, and are necessary for sizing heating equipment for the house in the "unoccupied" night-time condition, with no heat gains recognized. (There are a few—refrigerator, freezer, water heater, clocks.)

(2) Adjusted design, for use in estimating annual energy, includes a reduction factor of 80/85 to recognize that for the location considered the wind does not average 15 mph, but closer to 10. At the design condition (as to temperature), a difference of 1 mph represents about the same change in heat loss as is caused by a change of 1 degree in temperature difference. The ceiling loss is adjusted to 75/85, to recognize the wind protection afforded by the attic enclosure.

(3) No adjustment is made for floor losses, design or seasonal; all contributing factors have been taken into account in calculating the losses$^4$.

(4) For a well constructed and tight house, there can be little quarrel with the infiltration fresh air change of ½ per hour at the design condition. With the lower wind velocity and less TD, the average will drop below ½ air change unless continuous power ventilation is provided. I have arbitrarily estimated the average infiltration at ⅜ change per hour or 60 cfm, which will meet comfort requirements most of the time. This is 15 cfm per person for a family of four. It may be in excess of the actual average condition for the tightly constructed homes with straight resistance heating—no one knows for sure.

(5) Some further reduction, not made here, is in order to reflect the fact that part of the wall, window, and door exposures are always on the lee side of the house.

(6) The heat loss per sq ft for a 70° TD is shown here only to permit comparison with design heat losses in other climates.

(7) The formula for determining annual kwhr uses degree-days to the base 70F, since heat gains are recognized separately:

$$\text{kwhr} = \frac{\text{Btu/hr} \times 24 \times 8230\text{DD}}{3413 \times 85^\circ\ \text{TD}}$$

These energy estimates are more than the annual requirements for an unoccupied house, because of the solar radiation effects not recognized at this point.

(8) Body heat is computed from an average occupancy of 2.08 persons during the 24 hrs of the day at 400 Btu/hr or 5.8 kwhr/day for six months. Six months was chosen rather than our usual 9-month heating season to recognize that for many hours of the heating season the heat gains are not usable for heating but are partially or entirely disposed of by atmospheric cooling. This shows up markedly in the heavily insulated home.

(9) Water heater heat loss is about 3 kwhr per day, leaving 7 per day out of a total of 10 (or 300 kwhr per month) used for heating the water actually used. Half of this 7 is assumed to be lost down the sewer, leaving a total of 6.5 per day that goes to heat the house. This is 195 per month, or 1170 kwhr heat equivalent for the 6 months considered.

(10) The miscellaneous usage of electricity for other purposes within the heated space of an all-electric house is estimated at 400 kwhr/month or 2400 kwhr for 6 months.

(11) The 3421-kwhr heat equivalent of solar radiation contribution is simply the unaccounted-for balancing figure. (14,461 — 4614 + 1350 — 7776 = 3421.) (Floyd Olson probably assigns more credit than this to solar gains and less to other gains. The split I have used in the table is partial recognition of his observations.

(12) Latent heat loss is estimated at 1 lb water vapor per hour for six months. 1060 Btu/hr for 24 hours is 7.5 kwhr/day, 225 kwhr/month, and 1350 for the season.

(13) It should be noted that in arriving at this figure no consideration has been given to the effect of use of thermostat set-back or to the effect of other family habits. For the present, these are unknown variables; but they undoubtedly affect the heating energy consumption. Also, computing heat losses of a partially used basement is a special problem requiring separate treatment; it has been purposely omitted from this analysis.

This perhaps is taking some liberties; however the difference in design heat loss between my projected 12-6-6 insulation and Olson's is so small that it is reasonable to expect that 12-6-6 will give performance equal to the 0.9 heat factor.

The procedure detailed in the above tabulation is to accept the 7776 kwhr per year as the net annual heating requirement and, using established heat-loss factors and design heat losses, break down this figure into its component parts making such estimates as appear reasonable. If there be errors in some parts, there must be compensating errors in other parts. The absolute values are not so important in themselves as it is to show the many contributing factors, since a service will be performed if areas can be pointed out where there is need for further laboratory analysis and field tests.

### Conclusions

As indicated by the question marks, further exploration and determination of the effects of solar radiation upon the net heating requirements and of heat gains from miscellaneous uses of electricity are warranted.

Use of insulation in the ceiling, walls, and floor to produce U-factors of 0.021, 0.04, and 0.026 Btuh/deg TD, respectively, is something short of the limit which will still pay dividends for attic-type frame construction at usual present prices.

Fields for further reduction of annual heating requirement are in glass losses and fresh air supply. Glass losses could be reduced about 30% by using triple glass. That would pay off, provided the demand would increase production and reduce the price to one proportionate to that of double glass. Double glass plus storm windows pays out now.

An intriguing promise of energy saving through the heating of infiltration air is in prospect, while providing as a by-product 100% continuous forced intake and tempering of fresh air and forced removal of exhaust air. All that is needed is a heat pump device of about ⅕- to ¼-hp capacity. This is one application of the air-to-air heat pump that gives promise of a continuing market in the northern half of the country after power system winter peaks catch up with summer peaks.

For the home analyzed in the table, the FHA and NEMA estimating formulas may be solved for the correction factor, or constant, using 7776 kwhr annual energy and 23,000 Btu/hr (6.74 kw) design heat loss. The resulting factors are 250 and 13.6, respectively. Use of current values for these quantities unduly penalizes heavily insulated homes, since excessive annual energy and cost estimates will result. At the same time, this will not promote the use of economic insulation by home builders, with an end result which is not helpful to the ultimate occupants of the homes nor to the conservation of our sources of energy. Perhaps a curve relating correction factors to the design heat loss per sq ft of floor area could produce some realistic values for these factors.

All these possibilities point the way to bringing the annual cost of electric heating so low that just about anyone wanting it for a new home can afford it. Capturing more than half of the new home heating market is within reach for electricity suppliers and electrical contractors, given some developmental and educational effort.

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[1] "Electric Heat Can Cost Less," *Electrical Construction and Maintenance*, April, 1960.

[2] "Problems in Estimating Heat Losses," *Electrical Construction and Maintenance*, August, 1959.

[3] "It's Time for Electric Heat to Grow Up," *Electrical World*, June 29, 1959.

[4] "Calculating Floor Losses," *Electrical Construction and Maintenance*, January, 1960.

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# Design Heat Loss and The NEMA Constant

Development of a curve showing the variation in the NEMA formula constant with the design heat loss of a residence.

**By Howard S. Smith** and **Floyd Olson**
*Colorado Central Power Co., Englewood, Colo.*
*Electric Heat and Insulation, Salt Lake City, Utah*

THE NEMA formula for estimating annual electric heating energy uses a "constant" or correction factor" to modify the theoretical annual heat loss to account for such factors as heat gains from sources other than the heating system. **Obviously, use of the** same constant for two homes having the same "free" heat gains but different design heat losses will either overcompensate for one or undercompensate for the other. This suggests that different constants should be used for homes having different design heat losses.

The following procedure is suggested to provide a quantitative approach to the problem:

(1) Submetering of many heavily insulated homes with a design heat loss of 20 Btu/hr/sq ft at ½ air change per hr indicates that annual energy requirements can be estimated reasonably using the NEMA formula with a constant of 10.

(2) From information we have been able to gather, we believe that a constant of 20 must be used to give reasonable results for homes with heat losses in the neighborhood of 80 Btu/hr/sq ft.

(3) For the well-insulated average (1200-sq-ft) home with 20 Btu/hr/sq ft heat loss, the "free" heat gains may be considered to be approximately 50% of the total annual requirement. For convenience, we may consider this amount of heat to be one "unit" of heat loss. Then the annual heat loss will be equal to one such unit for each 10 Btu/hr/sq ft of design heat loss.

Thus for a house with 40 Btu/hr/sq ft design heat loss, a total of 4 units is required, 3 of which must be supplied by the heating system. In other words, the heating system supplies 75% of the total requirement. Similarly, for an 80 Btu/hr/sq ft house 8 units are required, 7 by the heating system—87.5% of the total requirement.

(4) If we know the NEMA factors for the two extremes considered (20 and 80 Btu/hr/sq ft), the factors for design heat losses between the two may be found by direct interpolation:

$$\text{NEMA constant} = 10 + 10\left(\frac{H - 50}{87.5 - 50}\right)$$

where $H$ = percent heat to be supplied by the heating system.

Thus for 20 Btu/hr/sq ft heat loss, H = 50%; the constant is 10 + 0 or 10.

For 40 Btu/hr/sq ft heat loss, H = 75%; the constant is 10 + 6.67 or 16.67.

For 80 Btu/hr/sq ft heat loss, H = 87.5%; the constant is 10 + 10 or 20, etc. These calculations are presented below in tabular form for sufficient heat loss values to plot the accompanying curve.

(5) Since orientation of the home is an important factor in the total heat requirement, it is proposed that the values of the NEMA constant as determined from the curve be corrected by a factor of 0.9 if the home faces south and by a factor of 1.2 if the home faces north. The curve values are to be used directly for east- and west-facing houses.

### *Detailed Analysis*

The above is a simplification of the following detailed calculations:

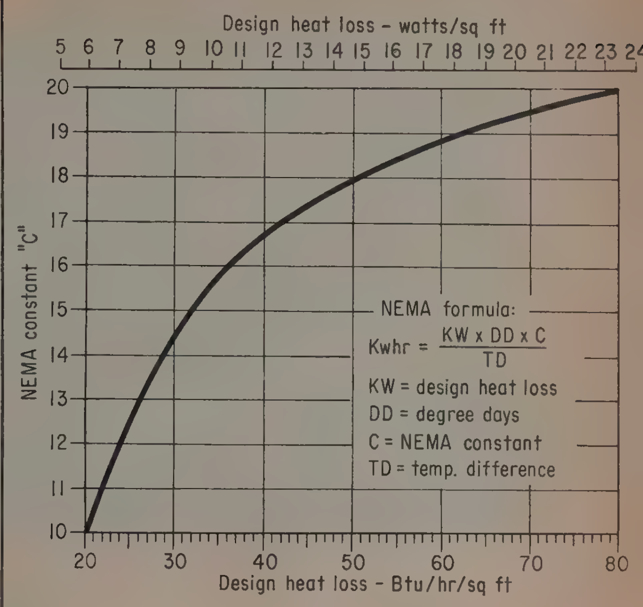
Assume as above that a 20 Btu/hr/sq ft design heat loss house has half its requirements supplied by heat from other sources.

$$20 \text{ Btu/hr/sq ft} \times 1200 \text{ sq ft} = 24{,}000 \text{ Btu/hr.}$$

$$\frac{24{,}000 \text{ Btu/hr} \times 24 \text{ hr/day}}{80 \text{ deg TD}} = 7200 \text{ Btu/deg-day}$$

If we have an average temperature over the heating season of 38.3F (Salt Lake City area), the heating system must furnish enough heat to make up a temperature difference of 70 − 38.3 or 31.7 degrees. Then 7200 Btu/deg-day × 31.7 = 228,000 Btu/day, the total requirement. Half of this is 114,000 Btu/day, the so-called "free" heat.

**NEMA Constant vs Design Heat Loss**



**CURVE POINTS** were plotted using calculated data given in table below. Upper scale shows design heat loss in watts/sq ft for use by those more familiar with this unit.

We assume this is constant and independent of heat loss; therefore a house with 50 Btu/hr/sq ft design heat loss would also receive 114,000 Btu/day from sources other than the heating system.

For such a house,

$$50 \times 1200 = 60{,}000 \text{ Btu/hr total design heat loss.}$$

$$\frac{60{,}000 \times 24}{80} = 18{,}000 \text{ Btu/deg-day.}$$

$$\begin{aligned} 18{,}000 \text{ Btu/DD} \times 31.7 \text{ deg} &= 570{,}000 \text{ Btu/day total requirement} \\ \text{Free heat} &= 114{,}000 \text{ Btu/day} \\ \hline \text{Difference} &= 456{,}000 \text{ Btu/day to be furnished by the heating equipment.} \end{aligned}$$

Thus 456/570 = 80% to be furnished by the heating equipment, which is the same figure given in the table for a 50 Btu/hr/sq ft design heat loss house.

### Calculated NEMA Constants

| Design Heat Loss (Based on ½ air change per hr) | | Heat Units | | | Percent total heat to be supplied by heating system | Calculated NEMA constant |
|---|---|---|---|---|---|---|
| Btu/hr/sq ft | Watts/sq ft | Total to be supplied per year | Free heat received per year | Net to be supplied by heating system | | |
| 80 | 23.4 | 8 | 1 | 7 | 87.5 | 20 |
| 70 | 20.5 | 7 | 1 | 6 | 85.7 | 19.5 |
| 60 | 17.6 | 6 | 1 | 5 | 83.3 | 18.9 |
| 50 | 14.7 | 5 | 1 | 4 | 80.0 | 18.0 |
| 40 | 11.7 | 4 | 1 | 3 | 75.0 | 16.7 |
| 35 | 10.3 | 3.5 | 1 | 2.5 | 71.5 | 15.75 |
| 30 | 8.8 | 3 | 1 | 2 | 66.7 | 14.45 |
| 27.5 | 8.1 | 2.75 | 1 | 1.75 | 63.8 | 13.68 |
| 25 | 7.3 | 2.5 | 1 | 1.5 | 60.0 | 12.75 |
| 22.5 | 6.6 | 2.25 | 1 | 1.25 | 55.5 | 11.47 |
| 20 | 5.9 | 2 | 1 | 1 | 50.0 | 10 |

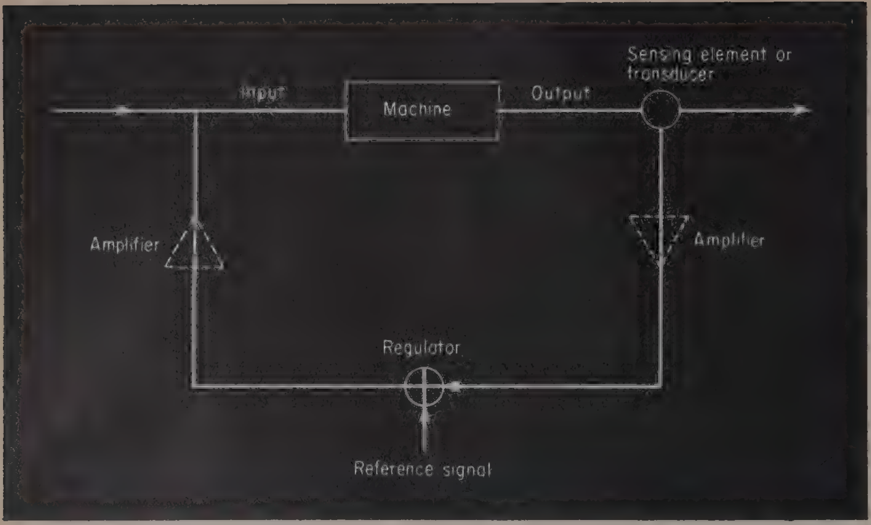


**FIG. 1**—Basic elements of a regulating system.

## *Operation and application of . . .*

# Industrial Regulating

An analysis of the characteristics of automatic regulating systems for industrial machine operations—pointing up selection and application of system components for various requirements.

**By C. G. Moon, Jr. and W. O. Hale,** *Engineers,*
*Westinghouse Electric Corp.,*
*Hartford, Conn.*

A TYPICAL regulating system consists of a number of interconnected elements as shown in Fig. 1. First, there is the regulated machine itself, with an input and an output. Then there is a sensing element which measures some characteristic of the machine output. Next there is a summing point or regulator which takes a signal from the sensing element, compares this signal with a reference signal and produces a correction signal to feed the input of the machine. This correction signal then modifies the input to reduce any difference between the actual and desired characteristic of the controlled output. One other component is found in many regulating systems. Although it is not evident in the basic logic, amplifiers are often required for practical reasons. The block diagram is basically the same for the simplest or most complex regulating system and serves as the basis for all regulating system designs.

Of all the parts of the foregoing system, only one seems to need further defining and that is the term "regulator." One dictionary defines a regulator as follows: "A device which functions to maintain a designated characteristic, as voltage or current, at a predetermined value, or to vary it according to a predetermined plan." Another definition which may be more apropos is as follows: "A regulator is a device which compares a function of the controlled variable to a reference and operates on the difference, introducing damping effects as needed, tending to reduce the difference towards zero."

It is not the intent of this article to go into the details of any particular type of regulator, but rather to discuss the types of regulating problems and how various types of hardware can be applied to solve these problems.

### *Typical Examples*

The following are examples of some common regulator applications:

**Tension**—In many manufacturing processes it is important to maintain constant or tapered tension. For instance, the correct forward and back tension on a metal strip is important during the rolling of the metal. Fig. 2. In the winding of yarn and paper, it is usually desirable to decrease the tension during the building up of

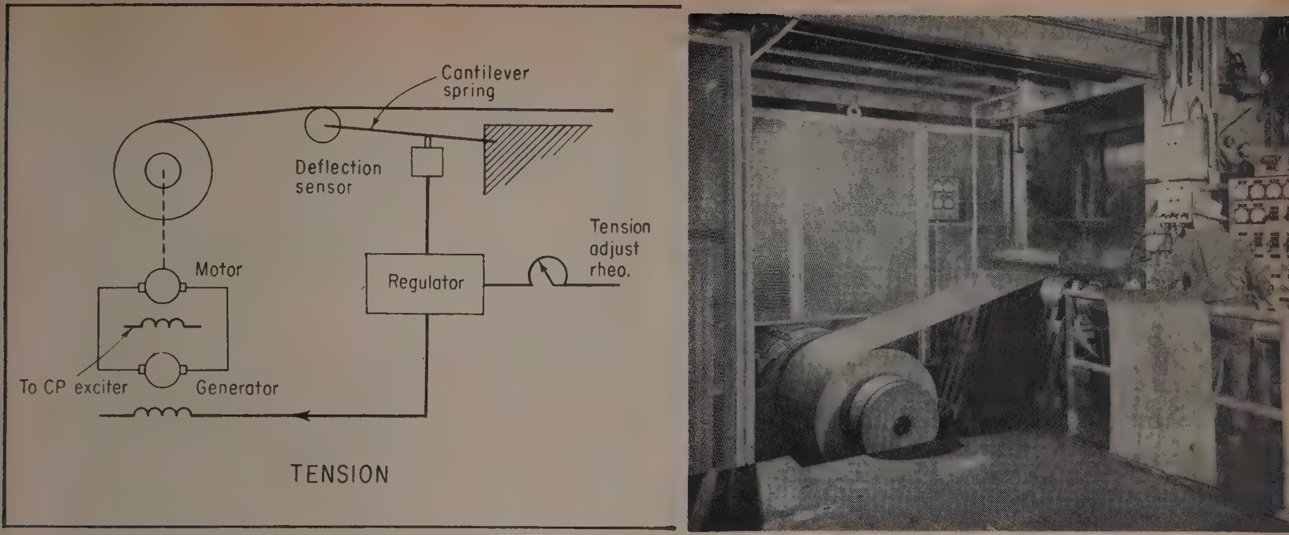


**FIG. 2**—Simple tension control system (at left) is type used for regulating tension at the wind-up reel on the delivery end of a tandem cold strip mill (photo at right). Generally, tension at the reels of a web or strip processing machine needs to be maintained at a particular value. In other operations, tension at a reel must vary as a function of coil size. Several types of regulators are used in tension control, with the type dependent upon the characteristics of the material and process involved.

# Systems

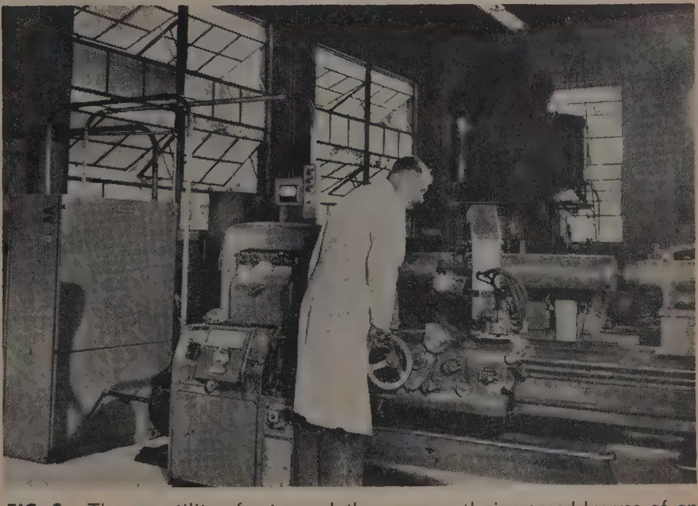


**FIG. 3**—The versatility of a tracer lathe was greatly increased by use of an adjustable-voltage drive which made possible constant surface speed, regardless of diameter. Before the new drive was installed, the lathe had to be stopped completely to change speed. With the new drive, a template with the cutting pattern can be placed in the lathe and the drive automatically adjusts speed to maintain a constant surface cutting speed.

the coil in order to end up with a neat package.

**Speed**—A good example of a speed regulator is the manner of maintaining constant surface cutting speed on a machine tool as the diameter of the work changes. With carbide tools, it is particularly important to maintain nearly the same surface cutting speed continuously. Consider a lathe where material is to be removed at a large diameter, as well as at a small diameter on the same piece. A speed regulator must be employed to change the work piece rpm over an adequate range if constant surface cutting speed must be maintained. Fig. 3.

**Position**—One example of a position regulator is the locating of a continuous printed strip of cardboard under a shear at the proper register mark so that no material will be wasted. Other common applications of a position regulator are a loop regulator where it is desired to maintain a definite length of loop in the processing of a material (Fig. 4), or the screwdown regulator which controls roll separation in steel mills.

**Current**—This is one of the most commonly used types of regulators. It simply involves measuring the current in a motor or generator and maintaining it constant. A fairly accurate tension regulator can be obtained by maintaining the armature current of a dc winder motor constant (while the build-up changes) by varying the motor field current. Fig. 5.

**Voltage**—A voltage regulator is probably the most common of all regulators. Fig. 6. Almost all ac generators require a regulator because of their inherent poor regulation. A dc generator may require a regulator if precise voltage must be maintained with changes in load.

**Torque**—Many times it is important to maintain a constant-torque output of a motor. One obvious case is that of a drive having mechanical equipment which will not transmit the maximum torque which the motor can develop. It then becomes necessary to limit the motor output torque to a value which is safe for the drive. Since the torque output of a dc motor is directly proportional to the flux and the armature current, if the flux is kept constant, the torque output is directly proportional to armature current. So, here again, a current regulator could be used.

**Acceleration**—A good example of a drive requiring regulated acceleration might be a sugar centrifugal. In many cases, this type of drive has such a high inertia that a standard motor would exceed rated temperature if allowed to accelerate the centrifugal without control. Thus, a regulator is applied to limit the motor input to a safe value during acceleration. Another example of such control is shown in Fig. 7.

**Deceleration**—A very commonplace deceleration control would be the stopping of a dc motor as fast as possible during emergency conditions. Obviously, if the motor is operating at weak field and dynamic braking is applied with full field on the motor, the armature current will rise excessively and may cause the commutator to flash over. Thus, we must "flutter the field"; that is, change from weak to full field and back in such a manner as to limit the armature current to a value which can be safely commutated. In this case, a simple field-fluttering relay is acting as deceleration regulator.

**Combination**—A regulator to maintain constant-horsepower input to a motor is an example of a combination regulator. This could be accomplished by two regulators controlling the same motor—one maintaining constant torque, and the other constant speed. Since horsepower is a direct function of torque and speed, then the horsepower would be regulated to a constant value. Another example of combination regulator is shown in Fig. 8.

### *Motor Drive*

One of the most important items in a regulating system is the motor. Therefore, let's consider the various motors—what their characteristics are, and how these characteristics can be modified.

Usually a synchronous motor is not thought of when regulating systems are being considered. Yet, when it is desired to maintain constant speed over a wide load change, this motor includes a "built-in" regulator. As long as the load is less than the pull-out torque of the motor, the speed remains exactly proportional to the line frequency. Normally, line frequency is held constant within very close limits. Furthermore, this motor has the correct "built-in" characteristics to maintain constant speed—even with an *overhauling* load.

If it is desired to change the speed of a synchronous motor, it is necessary to vary the frequency. In general, this can be done over a fairly wide range as long as the voltage is changed in the same direction and proportion as the frequency. Since this is the only means of speed variation (and usually an expensive one), the synchronous motor is normally used in regulating systems for constant speed applications and only occasionally in precise adjustable speed applications.

The second motor to be considered is the "work horse" of the industry—the squirrel-cage induction motor. This motor is nearly constant speed but does have a slip which is dependent upon both the load and the resistance of the squirrel-cage winding. Once this motor has been designed, it will have a fixed speed at a given load and this (like the synchronous motor) cannot be changed readily without changing the line frequency. Like the synchronous motor, this motor must have its correct voltage applied at all times (within 10%). Thus, it is not well suited to any except very special regulating systems.

The ac motor most commonly used in regulated systems is the wound-rotor motor. This motor is similar to the squirrel-cage motor, except that it has a winding on the rotor known as the secondary winding which is connected to slip rings. In addition, it is a fairly rugged machine. It has an added advantage in that its speed-torque curve can be changed by adjusting external secondary resistors. There-

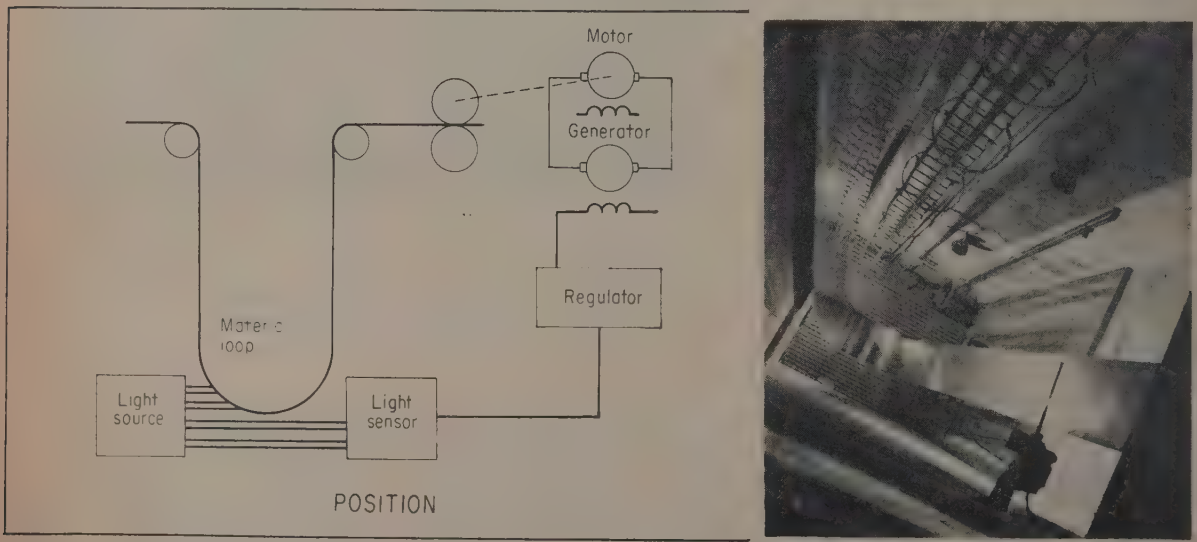


**FIG. 4**—A typical position regulator is a loop regulator. Photo-electric loop regulator (simple plan at left) maintains approximately 60 ft of material in the loop in a looping pit for a tinning line, while maintaining line speed of 1000 fpm.

fore, from the point of view of regulating systems, we do have a means of changing the characteristics of this motor quite readily and simply. Typical speed versus torque curves for a wound-rotor motor are shown in Fig. 9. Note the change in curve shape as external resistance is increased from no resistance at $R_0$ to maximum resistance at $R_6$.

It is evident from these curves that the speed or torque can be controlled by varying the external secondary resistance. Since the secondary current is nearly proportional to the torque, this is an easy means of measuring torque. Another very important point is that, since a large proportion of the secondary losses can be dissipated in external resistors, the motor can now be operated at speeds below synchronous speed continuously, as long as the torque rating is not exceeded. It should also be noted that this motor (with a fairly large amount of external secondary resistance) is far from self-regulating for constant speed with load change. As can be seen from Fig. 9, the speed-torque curves with high secondary resistance have a steep slope.

Inasmuch as there is more flexibility for changing the motor characteristics in the wound-rotor motor, we can conclude that this is the best ac motor for use in regulating systems.

Another method of controlling the speed of an ac motor is by unbalancing the voltages on the primary or secondary winding of the motor. This, of course, can only be used in short-time applications, since this system causes excessive heating in the motor. However, it is the method used in one of the fairly recent and more exotic regulating systems used primarily for cranes. This makes it possible to control the motor speed at both light and heavy loads.

The one motor which we have not discussed as yet is the direct-current motor. Probably 90% of regulating system drives, which involve a motor, use a dc motor. The first question which arises is, why use a dc motor when ac power is normally available in industrial plants, whereas dc power is not. The answer becomes quite evident as soon as the characteristics of dc motors and the relative ease of changing these characteristics are noted.

Consider the following three fundamental equations involving dc motors:

$$T = K\phi I_a \qquad n = K_1\frac{V - I_aR_a}{\phi} \qquad HP = K_2VI_a$$

Where T = torque, $\phi$ = flux, $I_a$ = armature current, V = armature volts, n = speed, HP = horsepower, $R_a$ = armature circuit resistance.

Considering the above equations assume first that the motor is supplied from a constant voltage bus. In this case, the flux can easily be adjusted by a motor field rheostat. Note that the torque is directly proportional to the flux and the speed is inversely proportional to the flux. Thus, in general the motor will have constant horsepower over its speed range by field control.

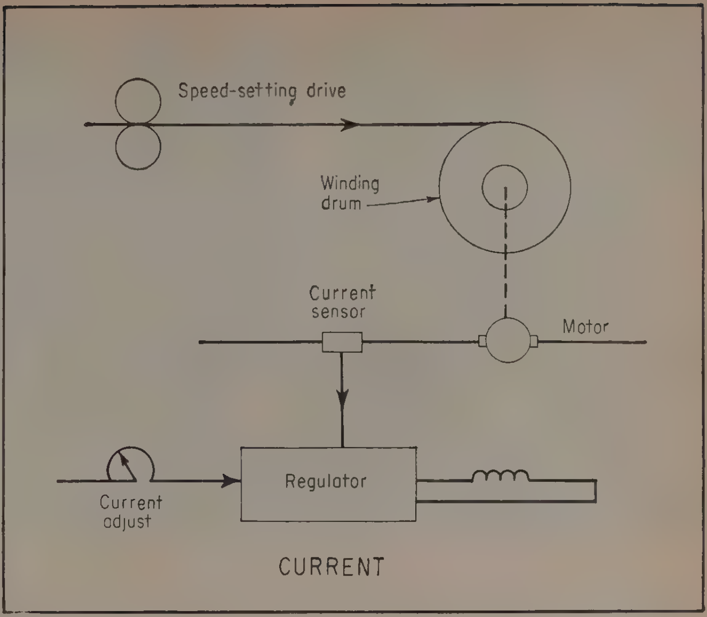


**FIG. 5**—Basic setup for current regulator, used to maintain tension constant in a winding operation by varying field current to a dc motor while holding armature current constant.

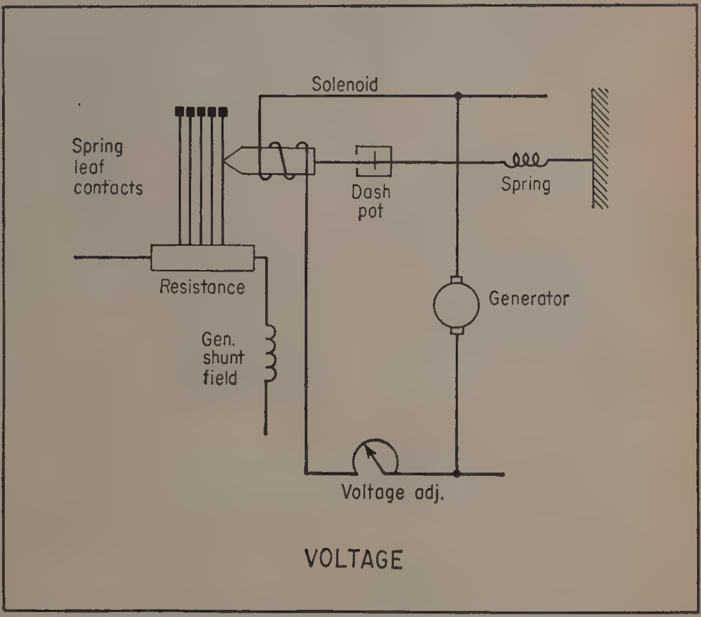


**FIG. 6**—Voltage of generator is regulated at constant value by automatic varying of current in shunt field. Solenoid armature moves against spring, damped by dashpot, to control shunting contacts connected to resistor taps, varying resistance in field circuit to automatically adjust generator output to required value.

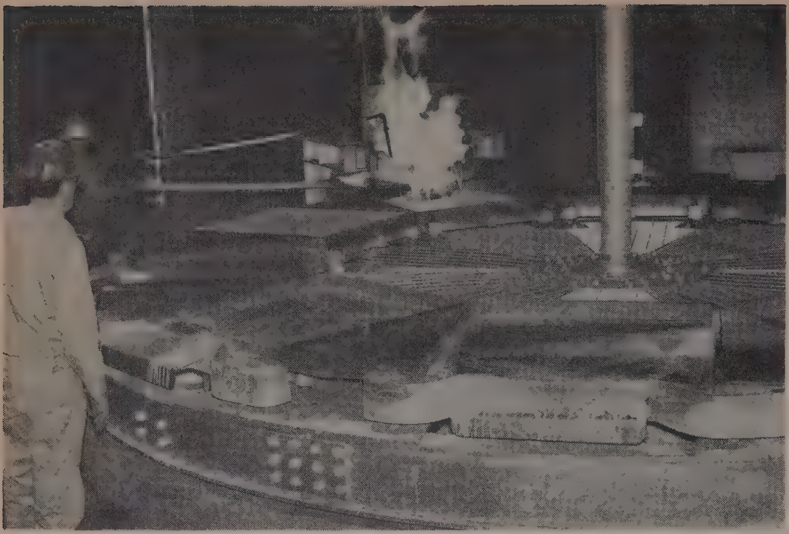


**FIG. 7**—Magnetic amplifier control is used to regulate acceleration in the casting of molten copper into anodes. As shown, the wheel mounts ten equally spaced molds around its periphery. During each (1½ minute) revolution, a mold is filled with molten copper that solidifies to form the anode, the anode is removed and the mold is reconditioned to receive molten copper again. In this process, starting, stopping, acceleration and deceleration must be smooth. Any jerking or sloshing motion would disturb the crystal structure of the copper, and cause problems in the process. In the control cycle, the wheel runs at 0.24 rpm after accelerating, until a limit switch initiates a slowdown and takes about 10 to 25 seconds to decelerate to 0.024 rpm. The wheel runs at this slow speed until another limit switch applies a suicide field to the generator to bring the wheel to a complete stop. A magnetic amplifier with a rate-of change feedback to control the generator field current solved this problem.

Since a supply of dc power usually has to be purchased, it is not much more costly to purchase an adjustable-voltage direct-current supply. With this supply and a simple field rheostat in both the dc generator and the dc motor fields, a more versatile drive is available. Now the dc motor flux and armature voltage can be controlled. Referring to the motor equation again, note that the adjustable-voltage supply makes it possible to easily control either torque, speed, horsepower, voltage or current, or a combination of these.

A dc motor then, because of its inherent characteristics and the ease with which these can be modified by the use of combinations of shunt and series fields, is a very important component of many regulating systems.

### *Sensing Element*

In a regulated system, some characteristic of the drive output is measured—either directly or indirectly—to compare actual performance with desired performance. The sensing element—also called a "transducer"—does this measuring. The function of the transducer is to determine the magnitude of the condition or characteristic to be controlled, and to provide an indication of this quantity which is suitable for use by the regulator. Even a partial listing of the many different types of sensing elements would take several pages and run from A to Z.

In the case of electric drives, the sensing devices with which we are most familiar are electrical or electro-mechanical devices and even these are too numerous to list here. However, they cover a complete range from resistance shunts for current measurement to plunger reactors and variable transformers for measuring position.

The choice of a transducer is governed principally by such aspects as accuracy, size, cost and reliability. As with most design problems, the simplest device which adequately satisfies the requirements is the best device.

### *Regulators*

The majority of regulator applications require one or two rather simple tasks based on measurable quantities. Thus, we are able to build devices which serve as excellent automatic regulators. As applied to modern electrical-drive regulating systems, these can be divided into four major categories: electro-mechanical, rotating, electronic and magnetic amplifier.

Electro-mechanical regulators were the first to be used and the functions of sensing and regulating were at times combined in a single device; however, the division is still usually discernible. For instance, in the field-fluttering relay, referred to above, the coil is the sensing element which supplies a flux signal, which the armature of the relay compares to its gap and spring tension settings, to determine whether the field strength of the machine should be changed.

Electro-mechanical regulators, in general, tend to be crude. However, for certain applications, their simplicity and low cost make them quite attractive.

As an example of a rotating regulator, consider the Rototrol which is one of several types available. It is primarily a multi-winding, dc generator which is operated over the straight-line portion of its saturation curve. At the present time the Rototrol's main attributes are: wide acceptance by industry, high power level of its output, and the ease of reversing its output. During the past five to ten years the Rototrol regulator has declined in usage because faster, more accurate regulators have been developed.

Where speed of response, potential accuracy, or low signal strength is very important, the use of the electronic regulator may be indicated. The major objections to the use of an electronic regulator are the use of limited life components and the lack of trained maintenance personnel to service them.

The other comparatively new device is the magnetic amplifier regulator. Although the principles have been known for about 50 years, materials and techniques to fully utilize these principles, have, for the most part, been developed within the past 15 years. In the magnetic amplifier, we have a compromise candidate which partially sacrifices some of the outstanding features of the other regulators in order to gain the reliability of a static device. The magnetic amplifier has neither moving parts, as does the electro-mechanical and rotating regulators, nor consumable parts as the emitter in an electronic tube. The magnetic amplifier consists, essentially, of rectifiers, resistors and multi-winding, saturable reactors.

Therefore, it can be expected that after initial adjustment the magnetic amplifier should be the most reliable regulator. Although the main attribute is rugged reliability, the magnetic amplifier also tends to be more stable than the electronic regulator. It does not require a warm-up period, as do electronic regulators.

Although the more important characteristics have been considered, it can be seen that each type of regulator has its place. Thus, if cost is all important, the use of an electronic or electro-mechanical system would be indicated. If accuracy is the most important requirement, the magnetic amplifier or electronic regulator should be considered. Or if the foremost concern is reliability, a magnetic amplifier is usually the best choice. For reversible regulator output, the rotating regulator provides reliability, economy, and high power outputs.

### *System Design*

In order to solve a particular regulating problem, it is necessary to combine the devices described above. One example of a regulating system problem is a center-driven winder for maintaining constant or adjustable tension while taking material from a machine. This is a common drive in the metal-working, textile, and paper industries. Basically, in this type of drive it is necessary to control the tension between the machine and the winder. It is often desirable to decrease tension slightly as the diameter increases in order to produce a better package. However, for simplicity only the constant tension drive will be considered. One interesting point here is that, for a given material speed, a constant tension winder is a constant horsepower load. This is easily illustrated by looking at the horsepower formula—HP = (F)(V)/K. In this case (F) is the tension force and (V) is the speed of the material. If the tension is constant for any given speed, the horsepower is also constant. We could, therefore, regulate either horsepower or tension.

First, consider the type of motor which might be used to drive the machine. Since winder speed must decrease as the roll diameter increases, and speed control of either the synchronous or squirrel-cage motors are expensive, these motors might not even be considered.

If a large resistance is inserted in the secondary of a wound-rotor motor, the speed-load curves are approximately linear. By proper choice of gearing, it is possible to make these linear curves nearly match the required constant-horsepower load curve and thus obtain an inherently self-regulating drive. The principal limitation to the wound-rotor drive is that the expected error in tension increases drastically as the winder speed or tension range increases.

If the required performance cannot be obtained from the wound-rotor drive, the use of a dc motor is indicated. Since the load plus the losses is equal to the input, if the losses are negligible, one approach would be to regulate the input horsepower to the motor. The input horsepower to the motor is equal to volts-times-amperes. Thus, one method of obtaining the desired tension regulation is to regulate both armature voltage and current. If there is a sufficiently stable voltage supply, the motor armature current alone can be regulated by adjusting the motor shunt field strength so that the desired current will be maintained.

So far, this problem has been approached only from the aspect of regulating horsepower. Since regulating input horsepower reduces errors due to losses, the problem could also be approached by attempting to regulate the tension directly. The most common way of measuring tension is to deflect the strip slightly and measure the restoring force caused by the tension force. The measurement of the tension in a more direct manner does tend to increase the accuracy; however, it also introduces mechanical time delays, reducing response speed.

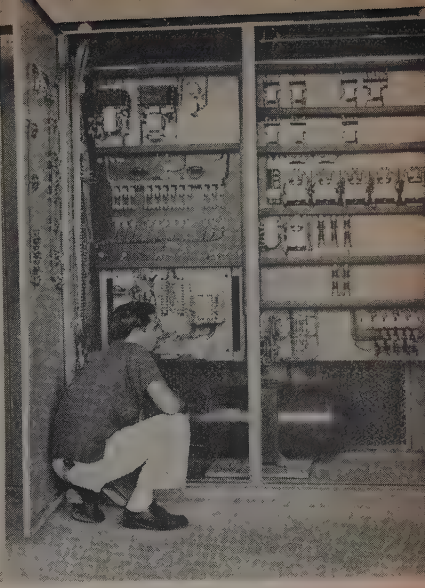


**FIG. 8**—Control cubicle houses a combined speed and position regulator for coordinating two adjustable-speed conveyor lines in an automobile assembly plant. The regulating system sees to it that parts for assembly carried on one conveyor are located within one inch of their mating parts on the second conveyor. A magnetic amplifier is visible just to the right of the man's head At the bottom of the cubicle is the adjustable-voltage dc generator that supplies power to the conveyor's drive motors.

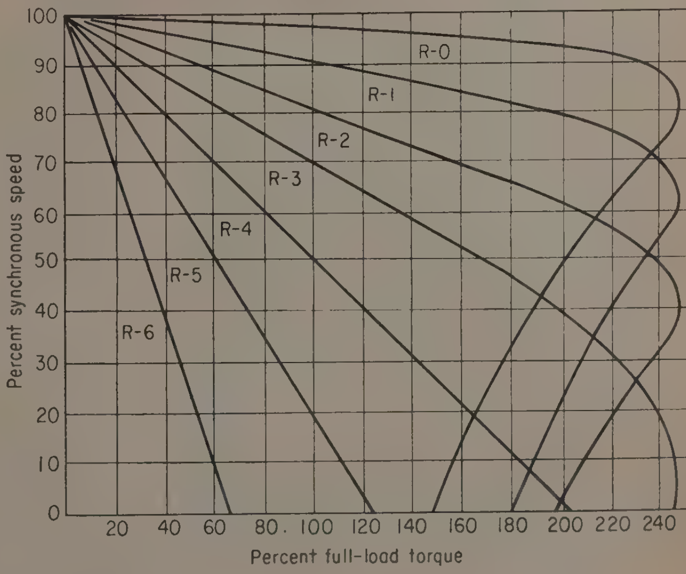
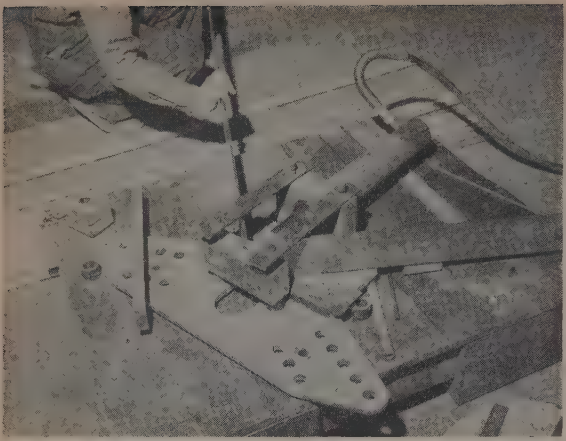
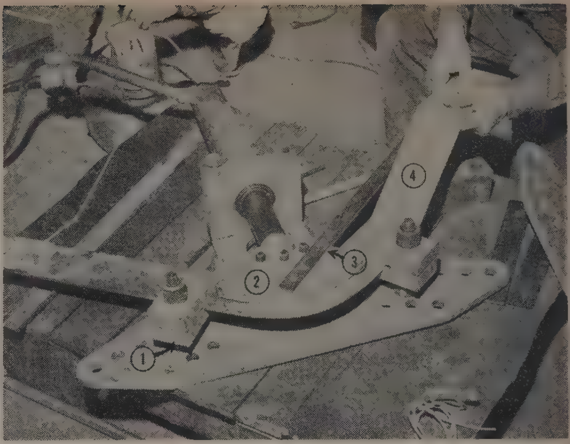


**FIG. 9**—Typical speed-torque curves for a wound-rotor motor, for various values of external resistance.



**EDGE-BEND** in copper bus bar made in hydraulic conduit bender. Top plate of bender is removed to show: (1) slotted guide-blocks; (2) fan-shaped bending shoe with screw-mounted top plate; (3) "angle-guide" bar; (4) bus section with edge-bend and flat-bend offsets.



**FLAT-BENDS** in bus are made with same bender using V-block die and associated ram head. Slotted guide-blocks (upper left) and fan-shaped ram shoe (lower right) are used with top plate for edge-bending.

# One-Shot Edge-Bending Of Bus Bars

**. . . streamlines plating bus installation; saves contractor time and materials; reduces customer maintenance to a minimum.**

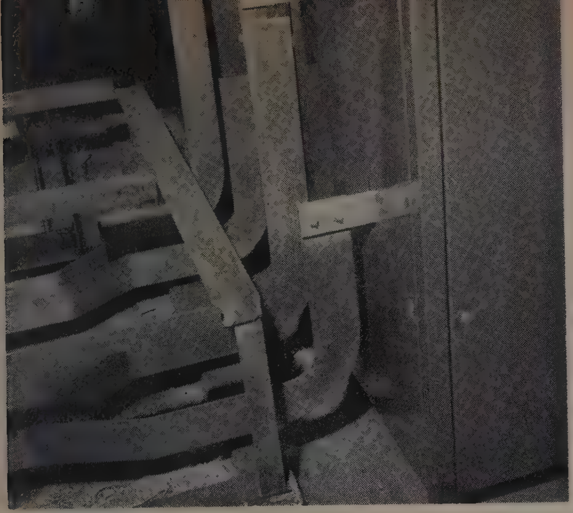
NEW and improved construction techniques play a vital role in the efficient installation practices and customer satisfaction offered by Premier Electrical Construction Company of Chicago. In fact, this concept is so high on their priority list that Premier President W. J. Templeman and Estimator-Engineer S. C. Wielgos normally hold an idea-session whenever a new job comes into the shop. The net result has been the development of numerous techniques that benefited both contractor and customer.

Latest innovation resulting from such a huddle was the adaptation of edge-bending to the installation of 12-volt bus bar distribution for electroplating systems at the Kellogg Switchboard and Supply Company and the Aurora Lamp Company and Continental Tube Corporation in Chicago. In one case, the multiple-bar circuits from the rectifiers were floor-mounted under a grate-walk and stubbed up to the plating tanks. In the other, the bus runs hugged the sides of the tanks. In both jobs numerous offsets, relatively limited work space and close tolerance posed installation problems.

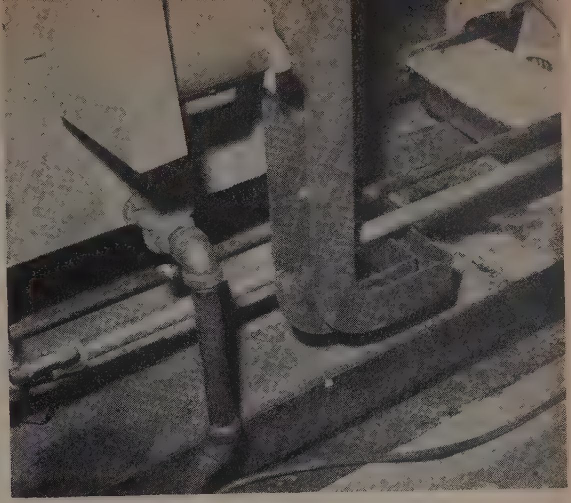
Premier's idea was to limit the number of joints and bolted offsets to an absolute minimum. By doing this the amount of cutting, drilling, silver plating and bolting of contact areas could be reduced substantially. Special 20-ft lengths of bus bar could be used to full advantage with minimum waste. Closer stacking of multiple bars permitted by the "jointless" offsets would meet space limitations and result in a more streamlined installation. And, with each joint that was eliminated went a possible future trouble point (contact areas). This would mean lower maintenance costs. To achieve all this, Premier decided to use a combination of flat- and edge-bent offsets wherever possible. The two jobs were engineered on that basis.

All bus offsets were formed with a conventional power-operated hydraulic conduit bender. Interchangeable attachments for flat- and edge-bending of the ¼-in. by 4-in. copper bus were obtained and modified to fit the job at hand. New holes were added to the bender plates to accommodate pins for the flat bend V-block die and the slotted guide blocks which support the bus for edge bending.

The key to accurate edge bending is the fan-shaped ram shoe with its bolted top plate. Three sturdy socket-head screws hold the plate



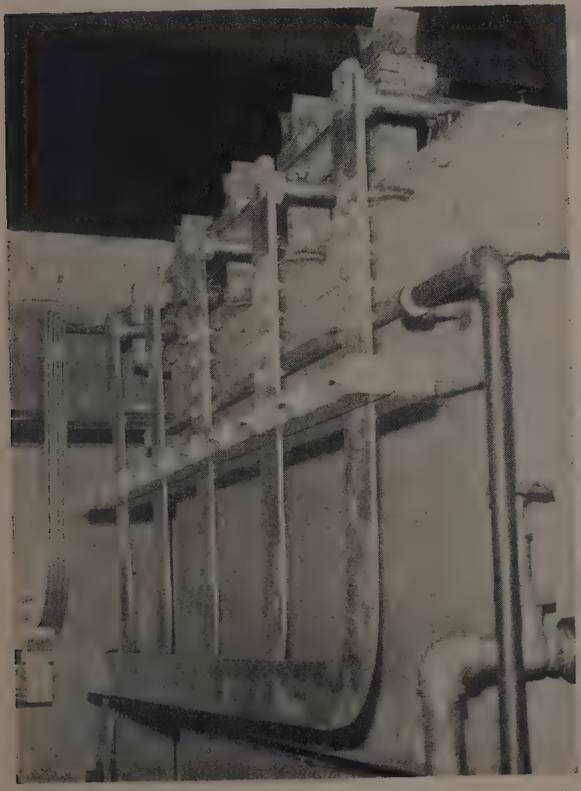
**ONE-PIECE BUS BARS** in floor-mounted runs are flat-offset and edge-bent to line up with rectifier terminals. Angle-iron framework supports grate-walk above buses.



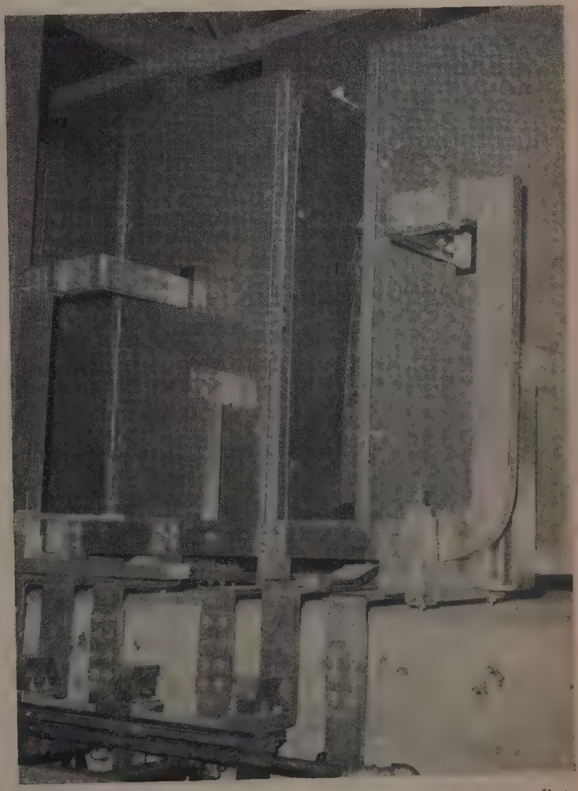
**TRIPLE-OFFSET** at plating tank stub-up combines edge-bends and flat-bends in continuous bars to minimize number of bolted splices.

securely in position and provide a firm "no-bind" grip on the bus as the shoe forms the right-angle bend. If these screws are tight, the copper at the inner radius of the bend will be as smooth as that on the outer radius. If they are loose, the inner edge of the bus will tend to plait or buckle. A flat steel bar, attached to the top of the shoe plate, serves as an "angle-guide" during the bending operation.

Once Premier mechanics became accustomed to the new bending technique, bus installation went along without a hitch. Field experience with hundreds of edge-bends showed no evidence of copper rupture along the outer edge of the bars. All anticipated advantages of this method were realized. And another field operation was added to the versatility of the hydraulic conduit bender.



**TRIM APPEARANCE** of bus bars hugging side of tank results from progressive edge-bent stub-ups of parallel bars.



**COMPLEX MAZE** bus distribution at rectifiers combines flat-bends, edge-bends, bolted taps and splices to best advantage.

TABLE I
RECOMMENDED VALUES FOR CIRCUIT BREAKER OIL

| Oil Properties | Column I<br>New Oil | Column II<br>Used Oil |
|---|---|---|
| Dielectric Strength | 27.5 KV Minimum | 22 KV Minimum |
| Neutralization Number | 0.03 MgKOH/gm oil—Maximum | 1.0 MgKOH/gm oil—Maximum |
| Interfacial Tension | 40 Dynes/cm—Minimum | 200 Dynes/cm—Minimum |
| Power Factor | 0.05%—Maximum | 0.1%—Maximum |
| Carbon Content | 0 | 0.5—Maximum |
| Fire Point | 149°C—Minimum | 144°C—Minimum |
| Flash Point | 132°C—Minimum | 127°C—Minimum |

Note: New oil should meet qualifications of Column I; oil in use should meet the values of Column II.

*Pertinent facts about*

# Circuit Breaker Oil —Tests and Maintenance

A comprehensive analysis of insulating oil properties, recommended tests and maintenance procedures of interest to all concerned with operation and maintenance of oil circuit breakers.

By **C. Feldman,** *Allis-Chalmers Manufacturing Company, Boston Works, Boston, Mass.*

THE PRIMARY function of oil in circuit breakers is to provide insulation and absorb the products of arcing resulting from circuit interruption. Frequency and severity of breaker operations determine the amount of maintenance required to assure adequate quality of insulating oil.

It is fundamental that new oil for initial installation in circuit breakers should be selected carefully for optimum operating and maintenance results. Experience indicates that electrical insulating oils preferably should be made from petroleum crudes rich in naphthenic hydrocarbons. The acid refining system is usually preferred for the manufacture of electrical oils. New oil should meet the recommended qualifying values of Column I, Table I. Oil in service should meet the value of Column II.

### *In-Service Testing of Breaker Oil*

With each circuit interruption of an OCB, the associated arcing "breaks down" a small amount of the oil. In addition, moisture and other extraneous contaminants may find their way into the most carefully protected breaker tanks to further reduce oil qualifications for continued duty. For this reason, the oil of breakers in service should be checked periodically to determine if it meets the qualifications of Column II, Table I.

Qualifications of used oil (for further duty) may be established by testing. However, no single test has been developed to give sufficient information to properly judge the condition of the oil. Instead, oil evaluation must be based on the combined results of a series of tests. These tests and the oil properties they evaluate will be discussed.

Oil condition is determined by testing samples of the oil in question. These samples must be taken carefully to make the tests valid. A generally recommended technique is to use a glass or metal "thief" that permits taking an oil sample close to the bottom of a storage tank or other container. Both thief and container for the sample must be thoroughly cleaned of all moisture for accurate results. For dielectric tests, at least one quart of oil should be taken as a sample. If complete physical and chemical tests are to be made, an additional quart sample will be necessary.

On oil circuit breakers drain pipes and sampling valves are provided at the bottom of breaker tanks for taking test samples. It is recommended that about one gallon of oil be run off through the tank valve and drain before taking an oil test-sample. This will flush out any foreign material that might have settled in the valve or drain and assure that the sample does not contain oil that was stored in the drain and valve. Following the "drawn-off" gallon, the next one or two quarts of oil should be the test sample.

A few additional precautions should be noted. Oil samples should not be taken in the rain, nor when the relative humidity exceeds 75%. Oil-sample temperature should be the same as the sampling thief or bottle to avoid condensation which would lower the dielectric strength test reading. Oil that has become turbulent in transport or when filling a tank should be allowed to settle for at least eight hours before a sample is taken.

Approved methods of sampling new oils or oils in service for several types of electrical equipment are described in ASTM D926-56—"Standard Method for Sampling Electrical Insulating Oils."

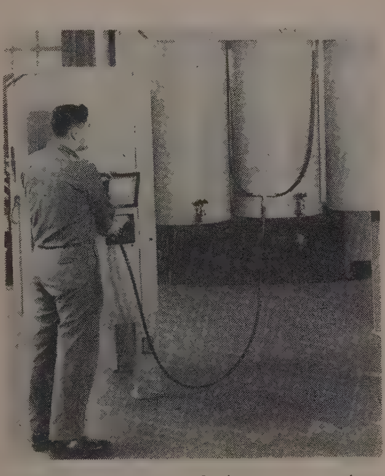
The following are the more common tests used to determine the oil properties indicated.

### *Dielectric Strength*

This test is widely used to indicate the voltage-withstand qualifications of insulating oil. It is a comparatively easy test to make. The equipment required is not complicated and may be operated successfully by personnel with limited training. It readily indicates degree of contamination of the oil but does not identify the contaminants. Low dielectric strength indicates the presence of moisture, the most prevalent cause of oil deterioration. In the process of getting into a circuit breaker tank (condensation inside the tank and leakage from the outside) the moisture will readily pick up impurities, bring them into solution in the oil, and together will effectively lower the dielectric strength of the oil. It has also been observed that moisture has set up electrical conducting paths with other foreign substances in the oil such as colloidal carbon, lint, or fibers.

Occasionally, dry oil will indicate high dielectric strength in spite of obvious discoloration and sludging. Such oil should be suspected of having poor service expectancy since the absorption by these substances of even relatively small amounts of moisture will result in oil of low dielectric strength.

Neutralization values are determined in accordance with ASTM Tentative Method D974-55T. This number serves to indicate the degree of oxidation that has taken place in the oil, the presence of harmful acids, and the fact that sludging has already occurred or can be expected. A periodic test showing a sharp increase in neutralization number over a previous test may be a warning of trouble.



**MODERN BREAKERS** have convenient means of lowering and raising phase tanks. This outdoor breaker has a hydraulic tank lifter which is operated in conjunction with the "Pneu-Draulic" operator. When the oil is shown by test to be questionable it is good practice to lower the breaker tank and inspect vital parts.

**PROVISION** is made at the bottom of the breaker tank for drawing off samples of oil for testing. Sufficient oil should be drawn to allow for the various tests.

### *Interfacial Tension*

Some of the advantages of this test include detection of the extent of oxidation, water content, and the presence of other contaminants in solution in the oil. The degree of sludging of the oil is also readily indicated by this test.

Although sludging in itself is not as serious a handicap to circuit breaker performance as it is to safe transformer operation, the diagram in Fig. 1 does indicate the value of the interfacial tension test in relation to sludging of electrical insulating oils.

### *Power Factor*

The power factor of insulating oil increases as oxidation progresses. It is also affected greatly by the presence of water and by small quantities of conducting and semiconducting oil-soluble contaminants.

This type of test is sensitive to the presence of contaminants in insulating oils. It does not identify the foreign material in the oil. When the power factor reading is above an established standard of 0.1% for used oil (see Recommended Value for Used Oil, Column II, Table I) further testing is indicated and recommended.

A running record of periodic power factor test results of the oil in a circuit breaker has been found useful for maintenance purposes. Gradual increase in power factor during the operating life of oil in a circuit breaker may be expected. However, a sharp increase in PF observed during a periodic oil test may serve as a warning that the oil has deteriorated sharply since the last test.

Carbonization of a small quantity of oil occurs in the direct arc area during each electric circuit interruption. Free carbon will eventually sink to the bottom of a breaker tank, but colloidal carbon and moisture may set up conducting paths that could flash over during high dielectric stress on the breaker. Chemical analysis to de-

### TABLE II
### FREQUENCY OF CIRCUIT BREAKER OIL TESTS

| OCB Rating | Electrical Tests | Tests for Deterioration |
|---|---|---|
| Up to 5 KV | Annually | Annual Visual Examination |
| 5 KV–34 KV | Semi-annually | Semi-annual Visual Examination |
| Over 34 KV | Quarterly | Tri-annually |

### TABLE III
### REPRESENTATIVE LABORATORY TESTS FOR ELECTRICAL INSULATING OILS

| Oil Property | Test |
|---|---|
| Dielectric Strength | — ASTM D877-49—Standard Method of Test for Dielectric Strength of Insulating Oil of Petroleum Origin.<br>or<br>Sphere Gap Method—Hemispherical electrodes, Standard for application are now under investigation. |
| Neutralization Number | — ASTM D974-55T—Tentative Method for Neutralization Value (Acid and Bare Numbers) by Color-Indicator Tritration. |
| Interfacial Tension | — ASTM D971-50—Standard Method of Test for Interfacial Tension of Oil Against Water by the Ring Method. |
| Power Factor | — ASTM D924-49—Standard Method of Test for Power Factor and Dielectric Constant of Electrical Insulating Oils of Petrolem Origin. |
| Color | — ASTM Color Scale Method D1500 |
| Fire and Flash Point | — ASTM D92-52—Standard Method of Test for Flash and Fire Points by Means of Cleveland Open Cup |
| Water Content | — ASTM D1315-54T—Tentative Method of Test for Water in Insulating Oils by Extraction<br>or<br>Karl Fischer Electrometric Method |

tect carbon or other contaminants in oil is valuable for circuit breaker maintenance as well as for maintenance of the oil itself. For instance, identification of excessive amounts of a given solid by chemical analysis would detect deterioration of the circuit breaker components made of that solid. This could indicate the need of preventive maintenance on the breaker as well as on the oil.

### *Fire Point and Flash Point*

Tests for these values in electric oils are useful mainly for acceptance checks on new oil. They are quite stable during the useful life of circuit breaker oil. It is reasonable to expect that oil would be discarded for other reasons before either the fire point or the flash point would fall below accepted standards.

### *Color Tests*

Although the color test is far from exact, it is simple to apply and may be used effectively as a supplement to other tests in evaluating the oil condition.

New insulating oil is light amber in color. Darkening of the oil during its life indicates change in the oil itself and in the percentage of dark-colored foreign matter in the oil. It does not follow, however, that dark oil is unfit for further duty. Samples of some oils have indicated high dielectric strength when dry although they were quite dark. Some companies have established their own standards of color shading as one of the indications they use to determine whether further and more exacting tests are warranted.

Water content tests are quantitative. An indication of over 20 ppm of water in solution in the oil predicates low dielectric strength.

### *Steam Emulsion*

Steam emulsion number tests may be used in detecting the presence of metallic soaps, bushing compound, sodium silicate, and semicolloidal material such as the hydros metallic oxides. This test was originally developed for lubricating oil maintenance and is used for electrical oil tests mainly in laboratories that have the equipment on hand.

### *Breaker Oil Test Program*

Testing circuit breaker oil is an integral part of preventive maintenance. These tests should be frequent enough to detect oil deterioration before it has progressed to an operating hazard. Adequate test schedules for these oils may confine breaker service down-time to periods when the oils are found to be below accepted standards for safe duty. A carefully organized test program will permit breakers to be withdrawn from service for oil reconditioning or change with minimum disturbance to the systems involved.

Frequency of operation, excessive currents interrupted, high ambient temperatures, excessive dampness or corrosive surroundings are all factors which determine how often the oil in circuit breakers of given design and age should be examined. One utility company has developed the test schedule shown in Table II.

### *Field-Test Techniques*

Field tests should be simple enough to be operated quickly and by personnel with limited training. These tests are used to classify oil that needs no further attention; requires laboratory test; or has become hazardous.

Dielectric strength tests are the most universally accepted field tests for circuit breaker oil. Tests for acidity and color tests are also accepted as valuable field tests. All of the equipments for these tests are simple and readily portable.

A means of generating high voltage (60 kv) or converting station voltage to this value and a means of raising the voltage gradually are needed for dielectric strength tests. A sample of the oil is placed in a cleaned cup of standard volume with two flat-disc electrodes 1 in.

in diameter and $\frac{1}{16}$ in. apart. Voltage between the electrodes is increased gradually until a flashover occurs through the oil. The average flashover voltage of a series of such tests on an oil sample indicates the dielectric strength of the oil.

### *Acidity Tests*

Tests to evaluate acidity of circuit breaker oils for "go-no-go" determination are described in AIEE Conference Paper No. 57-1145. For this test, three drops of a sodium carbonate solution are placed on a filter paper. When this has been absorbed, two drops of the oil are added in the center of the carbonate spot. When the oil has been absorbed, one drop of acidity (BDH Universal) indicator is placed in the center of the oil spot. The indicator undergoes color changes as it soaks into the oil. On oils of low acidity, the spot is characterized by a green center with a wide blue border. On oils of increasingly high acidity, the center of the test spot changes gradually in color from green to yellowish orange and the blue border decreases in width.

The acidity of the oil may be estimated with reasonable accuracy by visually comparing the color of he spot produced using an unknown oil to the colors produced in this manner with oils of known acidity. This conference paper also describes a polar contamination test hat offers similar visual evidence for field tests for interfacial tenion.

### *Color Test*

Field test equipment for color determination is much like the light meters used before photo-electric footcandle meters were developed. A lamp in a box is lighted by batteries through a rheostat to reguate the intensity of the light ource to an indicated value. The box is opaque except for a series of translucent apertures, each of which is numbered in accordance with a standard color. The color of a sample spot of the oil being ested is compared with the lighted pertures and color number of the il estimated by matching its color with the lighted apertures on the est box.

Exact determination of the proprties of new and used electrical oil equires the accuracy of laboratory testing. Individual company policy decides whether laboratory tests are made to supplement all field tests or whether they are made only on samples of oil referred to the laboratory by the field test supervisors. Representative laboratory tests for electrical insulating oils are listed in Table III.

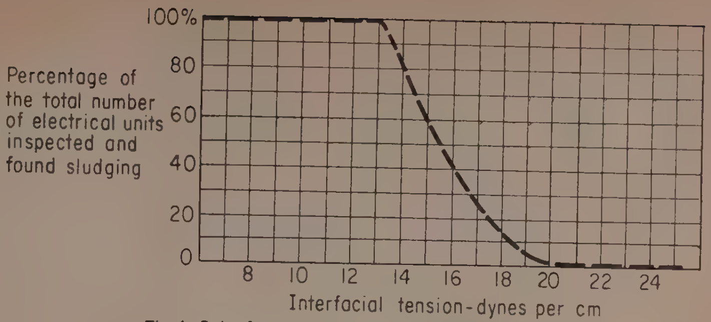


Fig. 1-Interfacial tension as indication of sludging

### *Oil Reclamation*

Circuit breaker insulating oil in almost any condition can be reclaimed for further duty. The economics of reclaiming used oil must be balanced against replacing it with new oil. The cost of multiple passes through purifying equipment generally rules out attempting to reclaim low quality oil. Several companies with a large number of oil-filled electrical devices report substantial net savings by reclamation of electrical insulating oils. The work of transporting used oil between the electrical power unit and the reclamation plant is not a significant factor compared to removal and disposition of the used oil and then refilling the tanks of an electrical unit with new oil.

The several variables in new oils and the different contaminants to which oils are subjected in service indicate that more than one process is involved in any successful reclamation system. Contaminants generally found in used electrical oil consist of water, fibre, scale, and sludge (all of which are removable by filtration) as well as acids and sludge in solution. Suspended sludge is a complex mixture of polymerized decomposition products such as varnish products, water, dirt, acid, etc. Free water has been found to contain soluble acids, aldehydes, other decomposition products, and mineral salts. After oil has reached the sludging stage, it will continue to sludge at an accelerated rate because of the catalytic action of the ingredients in the sludge. Oil reclamation, therefore, consists of: (1) converting as many of the undesirable substances in used oil as possible so that they are insoluble in the oil and can then be removed by filtration; (2) treating other contaminants so they are soluble in water and can be washed away; (3) chemically neutralizing contaminants not susceptible to filtration and the wash process; and (4) drying the oil processed in this manner.

### *Reclamation Equipment*

The essential components of reclamation systems for used circuit breaker oil include a means of; heating the oils to 175-185°F; bringing the oil in contact with Fuller's earth, activated alumina, or bauxite to remove acids; chemical treatment baths, water wash baths, filtration or settling tanks to collect solids; and a blotter press or vacuum centrifuge to remove moisture.

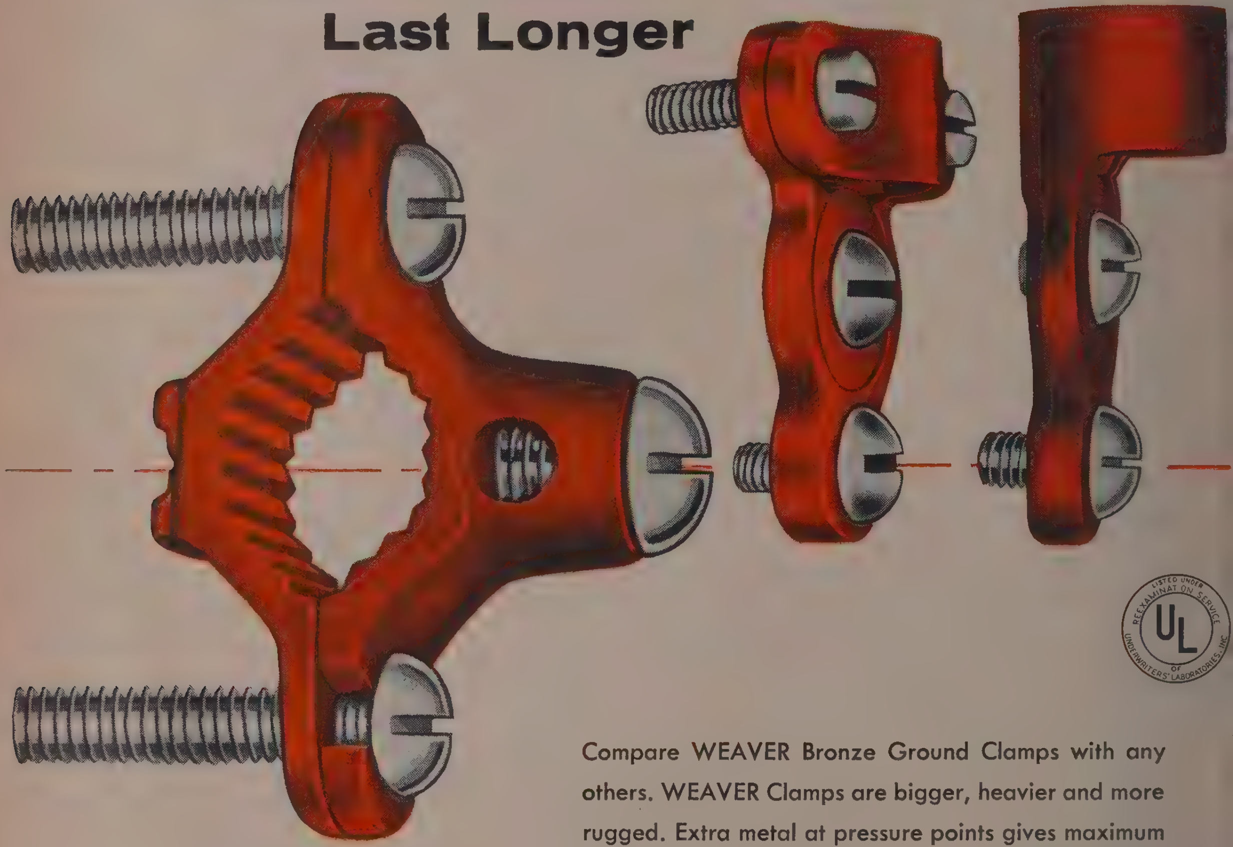
No single unit can be expected to adequately reclaim used oil because of the complex nature of new oil and the several types of contaminants commonly developed in oil in service. A good clay filter, for example, can effectively remove acids, can filter out solids, and can absorb some moisture. In the process, however, when the clay becomes saturated with water it would add, rather than subtract, moisture from the oil. A separate unit such as a blotter press, in which the blotters frequently are changed to dry ones, or a vacuum centrifuge should be employed to remove moisture.

Many companies use truck or trailer-mounted oil reclamation equipment to recondition oil in the

(Continued on page 229)

# WEAVER
## BRONZE GROUND CLAMPS

### . . . Easy to Install, Last Longer



Compare WEAVER Bronze Ground Clamps with any others. WEAVER Clamps are bigger, heavier and more rugged. Extra metal at pressure points gives maximum strength . . . increases conductivity. The all-bronze construction with heavily cadmium-plated screws prevents rust and corrosion . . . assures safe, permanent grounding. Swinging top eliminates loose parts to assemble and cuts down installation time. Only 3 types cover every grounding job. Sizes for ¼″ through 4″ copper or galvanized pipe.

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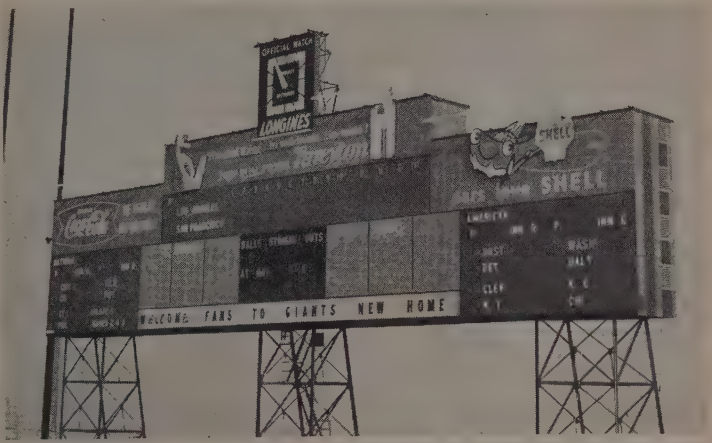
# Electronic Scoreboard

**Giant scoreboard in new San Francisco stadium is illuminated by three techniques involving more than 7500 lamps; game information being remotely operated from 2000-pushbutton console.**

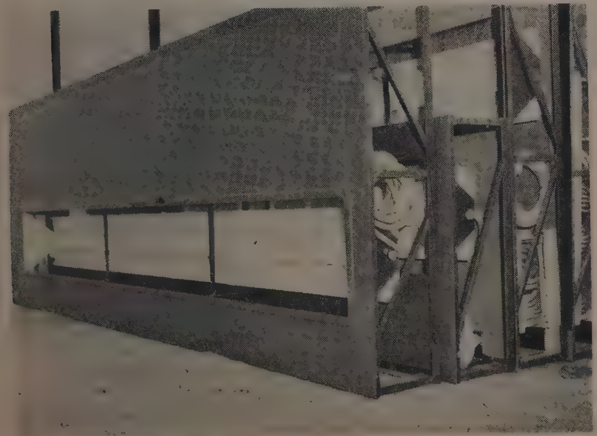


**HUGE SCOREBOARD** measures 160 by 52 ft has overall height of 95 ft and contains over 7500 lamps. Illuminated letters and numerals are 2 ft high. Control console containing 2000 pushbuttons permits instantaneous presentation of pertinent data without use of relays.

IN FOLLOWING game-action at San Francisco's new Candlestick Park, fans can check pertinent information on a scoreboard that is truly Big League in design and proportions. Having a width of 160 ft and an overall height of 95 ft, the board contains 2-ft-high letters and numerals illuminated by some 7500 lamps controlled remotely by a single operator working at a console containing approximately 2000 pushbuttons.

In presenting game information, three types of letter-illumination are employed: (1) slimline fluorescent lamps on 1-ft centers backlighting a 17-ft-wide clock and an 80-ft-wide translucent panel at the bottom of the board to announce coming events via silhouette lettering; (2) twin rows of 40-watt inside-frosted incandescent lamps staggered top-and-bottom on 6-in. centers along white porcelain-enamel reflectors behind luminous lettering of team names and inning data; and (3) nearly 200 40-lamp assemblies (eight rows of five lamps each) used to instantaneously record numbers of runs, strikes, balls and outs.

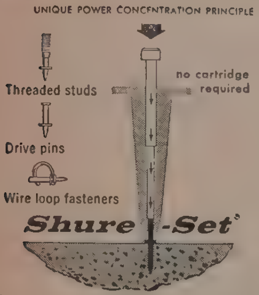
In these latter assemblies, numbers are formed by various circuiting arrangements of lighted 25-watt clear incandescent lamps; all lamps equipped with separate reflectors and recessed into the scoreboard behind individual wire-screens that safeguard lamps

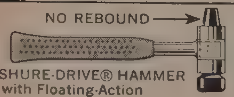


**ILLUMINATED TEAM NAMES** and legends consist of translucent Plexiglas letters set in 24-gauge metal panels. Backlighting is by means of 40-watt incandescent lamps staggered on 6-in. centers along central wiring channel in white porcelain-enamel reflector trough. Panels are galvanized, with exterior finish of weatherproof non-glare enamel.

**SECTIONS OF BOARD** were completely prewired for both power and control at manufacturer's plant prior to trucking to stadium where they were assembled in proper sequence, raised by boom truck and bolted into position. Designed and constructed by Spencer Display, board was electrically connected at site by Ad-Pact.

Progressive Contractors use SHURE-SET
FOR GREATER FASTENING EFFICIENCY





NEW SHURE-DRIVE® HAMMER
with Floating-Action

Newly-patented hammer actually absorbs shock, increases power and reduces worker fatigue. Ask for model R-400.

*other products by*

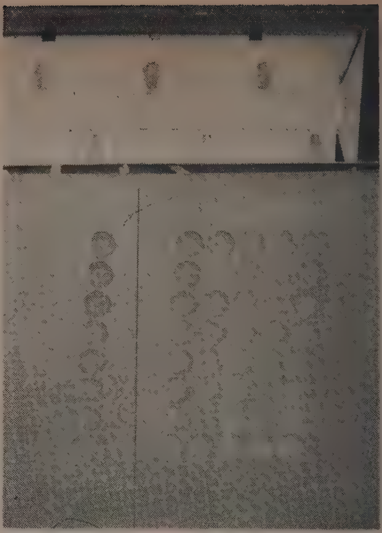
Simple–quick–safe–economical... these are a few of the reasons for the rapid acceptance of Shure-Set by electrical contractors everywhere! They have found the Shure-Set hammer-in system is an ideal way to set threaded studs, drive pins or wire loop fasteners through wood or thin metal into concrete with very little effort or expense.

Shure-Set requires no cartridge—a few hammer strokes do the job—from fastening raceways and panels to securing conduit clips and junction boxes, all without drilling or plugging!

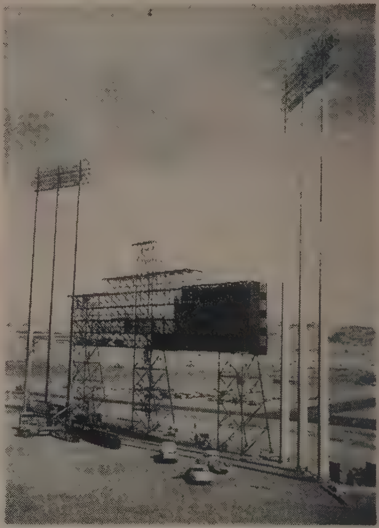
It makes good sense to use Shure-Set wherever you need truly economical, dependable fastening. Get the money-saving details on all electrical applications from your Ramset dealer (under "Tools" in Yellow Pages) or write us direct.

**Ramset® Fastening System**

OLIN MATHIESON WINCHESTER-WESTERN DIVISION
285-G Winchester Ave. • New Haven 4, Conn.



**FIGURAGRAMS,** measuring 2 ft in height, permit instantaneous changing of numbers to record balls, strikes, hits, etc., while similarly-constructed alphagrams permit changing of letters pertaining to playing positions, etc. Recessed 25-watt clear lamps are equipped with sunlight filter screens for improved visibility and protection.



**TOTALLY-ENCLOSED STRUCTURE** has four interior decks running full width of scoreboard to permit cleaning, relamping and general maintenance work from the inside. Mammoth size of this scoreboard is indicated by comparative size of cars and men seen at base. Operation of all lights and control circuits is at 120 volts; power being obtained through 600-amp main breaker of local switchboard.

against breakage and improve visibility under bright sunlight conditions.

Cleaning of reflectors, replacement of lamps and maintenance of wiring and electronic controls is performed from inside the totally-enclosed 4-level solid-deck struc-

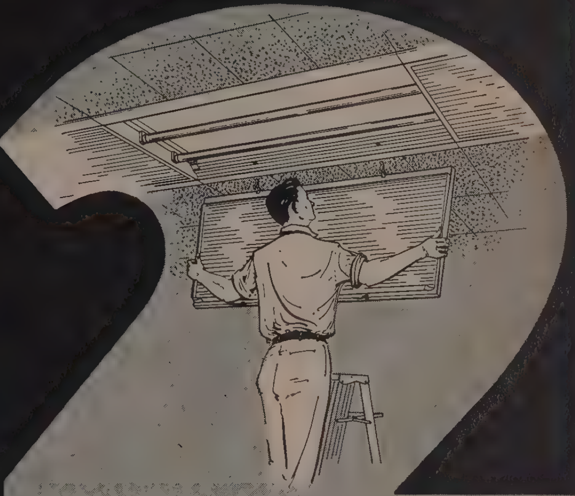
# FOUR WAYS TO SAVE IN LIGHTING WITH

# shallobeam®

TOTALLY INTEGRATED SHALLOW RECESSED LIGHTING SYSTEM

**INITIAL INSTALLATION SAVINGS**

This ultra-shallow recessed "light package" by Sunbeam Lighting Company, has integral mounting bars. The fixtures just snap into most ceilings drastically cutting installation time. No extra parts to buy either. Unobstructed wireway in continuous rows of 2-lamp units eliminates the need for AVA wire for circuit wiring which adds considerably to your initial savings.

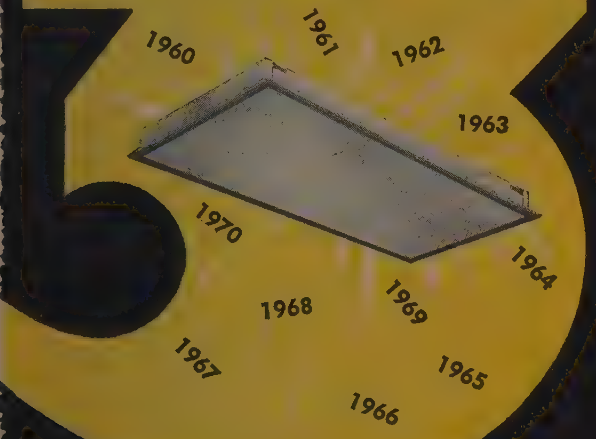


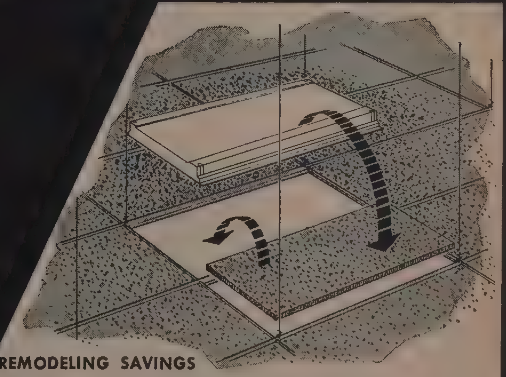
**MAINTENANCE SAVINGS**

Normal maintenance time can be cut up to ⅓ for long term savings "pay-off." No tools required. Diffuser panels just hook off and on for cleaning. No parts to remove for access to ballast or wireway. Diffusers are precision fitted to minimize dust accumulation.

**OPERATION SAVINGS**

Shallobeam® will look new longer. The highest standards of quality control assures real, long-term operational savings. All metal parts are Bonderite treated for an enduring resistance to corrosion. The durable, baked white enamel cleans easily without marring.





**REMODELING SAVINGS**

Shallobeam,® with its snap-in mounting feature, makes fixture relocation almost as simple as removing an acoustical tile. Here is a lighting unit that permits maximum flexibility in changing floor plans and shifting partitions. No new fixture costs need be considered unless increased illumination levels are desired.

*Write today for bulletin D-99 if you would like to know more about this unique lighting system—the Shallobeam.®*

Patents pending.

**SUNBEAM LIGHTING COMPANY**
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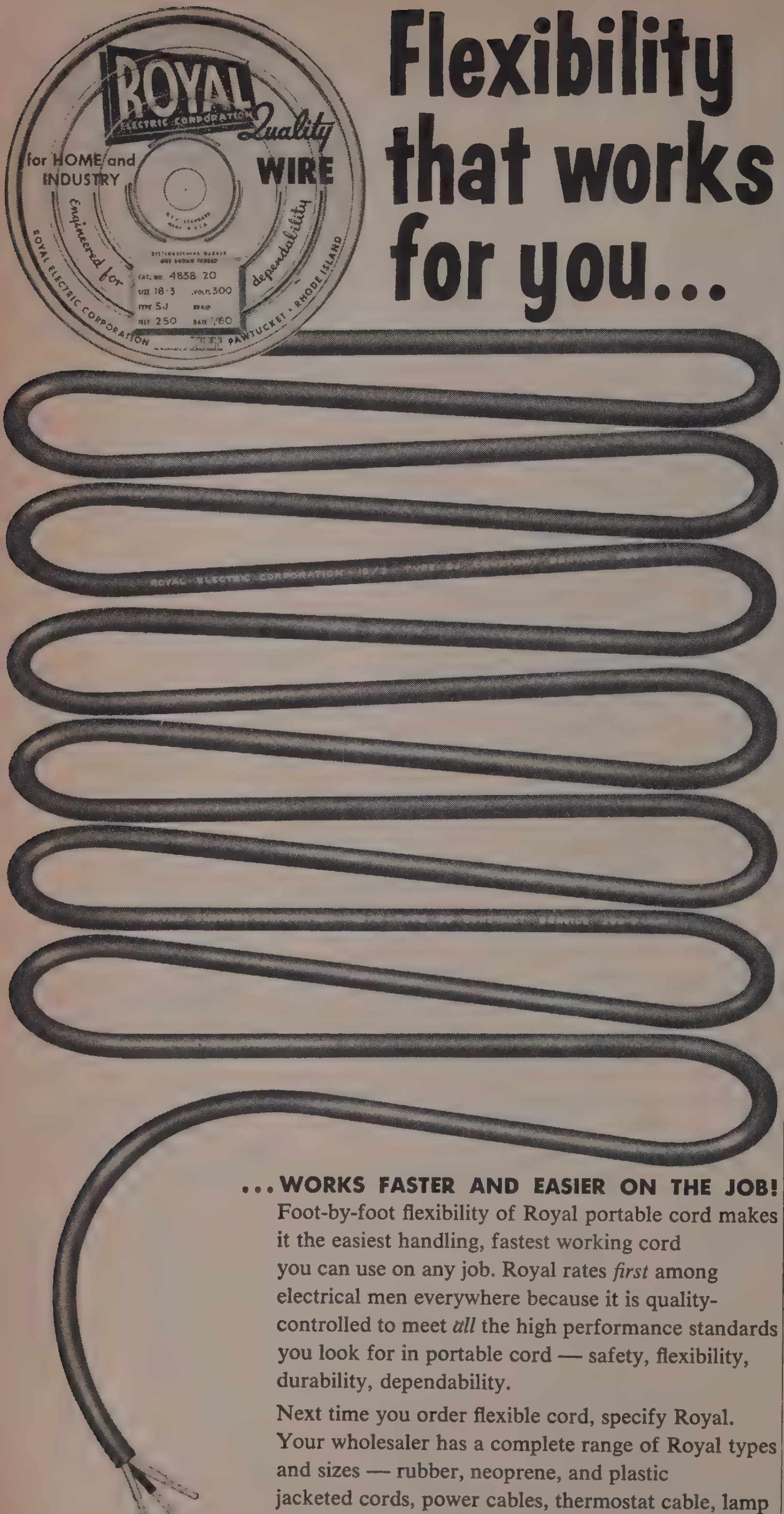
SUNBEAM visionaire Lighting Company

# Flexibility that works for you...



**...WORKS FASTER AND EASIER ON THE JOB!**
Foot-by-foot flexibility of Royal portable cord makes it the easiest handling, fastest working cord you can use on any job. Royal rates *first* among electrical men everywhere because it is quality-controlled to meet *all* the high performance standards you look for in portable cord — safety, flexibility, durability, dependability.

Next time you order flexible cord, specify Royal. Your wholesaler has a complete range of Royal types and sizes — rubber, neoprene, and plastic jacketed cords, power cables, thermostat cable, lamp and fixture wires, machine tool wires, and heavy-duty "POWR-KORD" extensions. Priced right, too!

ROYAL ELECTRIC
...an associate of IT&T

ROYAL ELECTRIC CORPORATION
PAWTUCKET, RHODE ISLAND

**FLANKING FLOODLIGHT TOWERS** are operated at same voltage (120) as scoreboards, although lighting of adjacent parking areas is via mercury-vapor units receiving 480-volt current through additional stepup transformers located at same substation.

ture. Changing lettering for Coming Events is accomplished from movable ladders suspended from the top of the board.

This board is also designed for use at football games, track and field events; legends then being changed to read "downs," "yards to go," "quarter" and "ball on . ." instead of "balls," "strikes," etc. Such conversion also includes a modern type of numeral-flashing time-remaining clock.

This mammoth $238,000 scoreboard was completely prewired (for both power and control) at the manufacturer's plant, trucked halfway across the country in sections, assembled in planned sequence upon delivery at the stadium, raised by boom-crane into position on the 50-ton steel framework, then bolted together to form the completed unit.

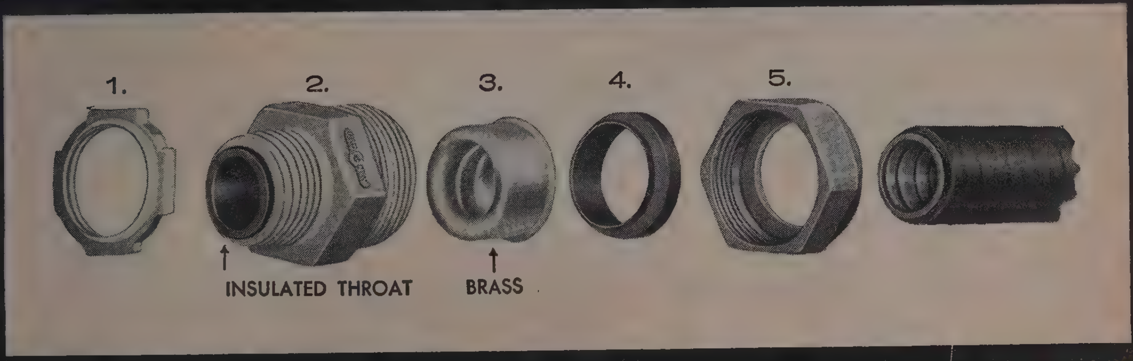
Designed by the Spencer Display Corp. of New York City, the board was constructed and pre-wired in their plant in Milwaukee, Wis., then assembled and erected by the Pacific Ad-Pact Corp., San Carlos, Calif.

## Mobile Rigs Facilitate Installation Routines

Two special mobile rigs greatly facilitated movement and installation of lighting system components

BEST NEWS YET IN LIQUID-TITE CONNECTORS

# Gedney insulated throat for top protection, easier pull-through



## MALLEABLE IRON

Now you can order Gedney Liquid-Tite Connectors with the added protection of insulated throats. You get faster, easier pull-through . . . eliminate dangerous wire fraying. Gedney Liquid-Tite Connectors are the finest, most efficient connectors available for use with liquid-tite conduits. They're precision-made from top grade malleable iron . . . designed to give lifetime dependable service in oil- and water-tight flexible raceways.

Gedney Liquid-Tite Connectors are supplied in standard sizes from ⅜" to 2" . . . straight, 45° or 90° . . . with or without insulated throats. Be sure . . . specify Gedney.

**As shown from left to right in illustration, Gedney Liquid-Tite Connectors consist of:**

1. Locknut — nut stock steel — cadmium-plated.
2. Main fitting — straight, 45° or 90° angle — malleable iron — cadmium-plated. Insulated throat — optional.
3. Grounding brass bushing — 1 piece — threaded to engage spiral of all type conduits.
4. Molded Vinylite sealing ring — pliable — ever-lasting.
5. Gland nut — malleable iron — cadmium-plated.

**GEDNEY FITTINGS FIT**

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NEW...FROM HEINEMANN

200 AMP SERVICE ENTRANCE EQUIPMENT

. . . small box
. . . big breaker

Customers looking for more electrical power will find a lot to like in this unit. Capacity is a full 200 amperes. "Full" because the Heinemann hydraulic-magnetic breaker makes de-rating as obsolete as yesterday's weather forecast. You can put this equipment next to heat lines, or let it sizzle in the summer sun. It always carries full rated current, always trips as specified. No thermal elements . . . no temperature-caused nuisance tripping.

Installation? Painless. There's enough space inside for two hands *and* wire. Solderless screw-type connectors save time and trouble. Knockouts are plentiful, placed so conduit can be run-in from any angle.

Cost? A little less than you are used to paying for equipment that supplies equal capacity *after de-rating*.

The size is another pleasant surprise . . . slightly smaller than fused pull-outs of the same rating. The equipment is rated at 120/240V AC, two- or three-wire service, and is available in indoor or raintight, tamperproof outdoor enclosures of heavy-gauge steel.

MORE QUESTIONS? SEND FOR BULLETIN 1003

HEINEMANN
ELECTRIC COMPANY
132 Plum Street, Trenton, N. J.
Circuit breakers

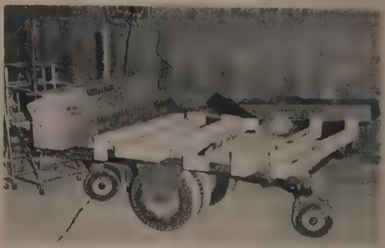
S.A. 2044

when the Foothill Electric Co. concentrated their construction knowhow on the million-sq-ft 28-story Kaiser Industries headquarters building now being completed in Oakland, Calif.

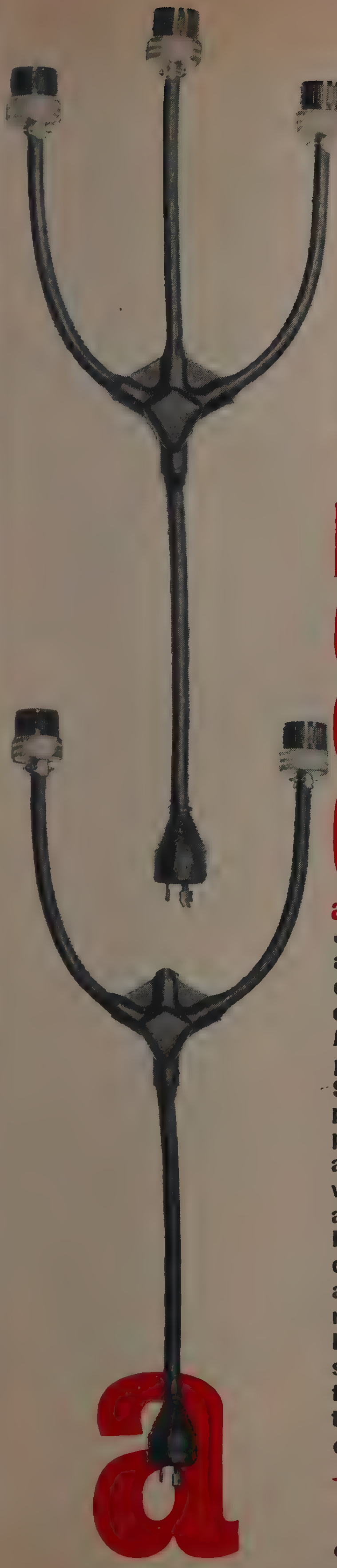
One of these rigs is a rubber-tired flat-platform dolly with weight supported mainly by a fixed 4-wheel assembly located beneath the centerline of the dolly's flat bed. In addition, two smaller 2-wheel assemblies are positioned beneath the two ends; these wheels being raised slightly from a straight-line base plane, to permit the platform to teeter or see-saw to a slight degree on the central axle; and end axles being supported by swiveling yokes to permit effortless turning, regardless of which set of wheels is in contact with the floor at that instant.

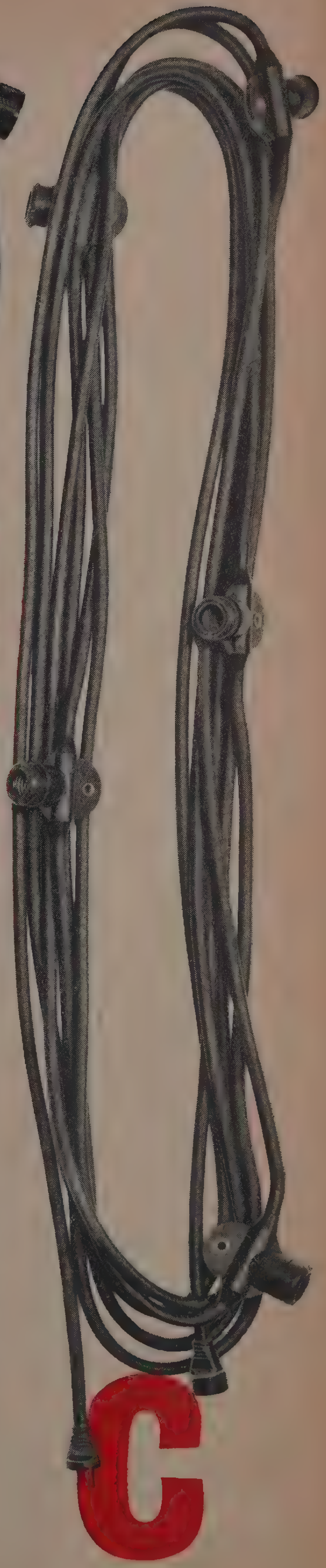
With this arrangement of wheels, the platform can be tilted and rotated in minimum space. Another important plus-value relates to the spacing of the double tires at each bearing point, for by this arrangement it is possible to roll the rig over a cellular floor in any direction without the danger of a single wheel slipping down between the cells. And, with weight distributed through many rubber-tired points of support, the rig can be rolled safely over floor-serving branch conduits even before top slabs have been poured, without danger of bending or flattening relatively soft aluminum conduit by concentrations of weight at any one point. Also, since the rig was dimensioned to pass through normal doorway and elevator gate openings, it can be moved from area-to-area and floor-to-floor as needed.

The second mobile rig takes the form of a 2-step lightweight ladder,



**TEETERING DOLLY** has three axles; those at each end being swiveled and raised slightly above base plane so that platform can be tilted and rotated at will to facilitate movement of unit. Presence of many rubber-tired support points lessens concentration of weight at any one spot; permits unit to be rolled over cellular-floor construction in any direction without having wheels slip between cells; distributes weight so that uncovered conduit will not be damaged.





# LOWER YOUR ON-THE-JOB COSTS WITH CORNISH

**a.** **CORNISH "Y" AND "W" COR-LOCK POWER JUNCTIONS** increase the number of available outlets, provide properly insulated connections and eliminate possibility of disconnection of any tool once connected. All wiring device components are UL approved. **b.** **CORNISH HEAVY DUTY EXTENSION CORD SETS, TWISTLOCK TYPE,** for positive locking of male and female components...rated at 20 amperes, 250 volts 10 amperes, 600 volts and 15 amperes, 125 volts 10 amperes, 250 volts. Components are UL approved. **c.** **CORNISH PORTABLE LITE-LINE** for wherever temporary lighting or power is needed. Molding to connectors and sockets provides full protection from rough handling and weather. Standard Lite-Line is supplied with 10 ft. spacing between sockets; has shade-holder grooves for reflectors or lamp guards. ■ All 3 available through electrical distributors from coast-to-coast.

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Smaller sizes are packed on spools in cartons . . . Larger sizes in coils, in knockout cartons . . . Easy to identify anywhere . . . Type, size and gage, clearly marked on jacket . . . Safe to recommend . . . Premium quality, long lasting, oil-resistant, neoprene jacket . . . U.L. approved.

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**LIGHTWEIGHT STEPLADDER** was dimensioned so that workers could stand upright without ducking, and could reach level of lighting fixtures and overhead conduit without undue stretching. Rubber-capped legs hold ladder steady when in use, while castered wheels can be lowered by lever action to facilitate movement of rig to another working position when so desired.

equipped with low railings for safe leg confinement; rubber-capped corner legs that provide steady non-slipping support, and corner castors that may be forced down by lever action when it is desired to take the weight of the ladder off the legs to roll the rig to another location.

These ladders were specially dimensioned for this large project; the height being determined by the height of the coffer ceiling, so that workers could stand upright while working without necessary ducking or undue stretching to reach the level of component installation.

## Tool Investment Pays Off On Air Force Job

Part of an electrical estimate for work at an Air Force base called for cutting concrete runways a distance of 180 ft at two different points for the placement of four runs of Transite conduits. In addition, the conduits would be covered with concrete fill, then backfill tamped in, and finally the finish concrete would be applied to match the existing runway surface.

Ordinarily, the cutting and finishing of the concrete would be sublet to a masonry contractor.

However, George Kassay, president of Kassay Bros. Inc., electrical contractors, Smithtown, N. Y., took a second look at the situation after receiving several sub bids for the concrete work. The lowest bid submitted seemed high. He then in-

**NIAGARA**

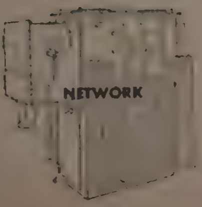
**TRANSFORMERS**

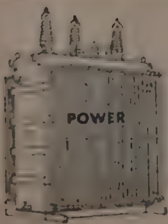
*"That Niagara was out there when I started. It's been delivering power since it arrived. Never caused us a moment's trouble."*

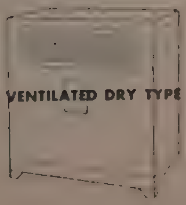
Users confirm it: Niagara Transformers are built to last a long, long time. At every stage in their manufacture, quality is strictly controlled. Everything — raw materials to completed transformers — is thoroughly tested at the Niagara plant. Specialized skills and experience assure bonus construction with liberal overload capacity.

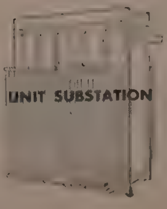
Niagara Transformers are designed and produced for practically every service thru 10,000 kva, 69,000 volts. Write for Bulletin 139. Niagara Transformer Corp., P.O. Box 23, Buffalo 25, N. Y. Representatives in principal cities.

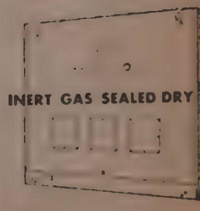
"After all these years, the breaker's never been opened."











what do you want in a flexible control cable?

You'll find it in

THE BIG NEOPRENE LINE...

BRONCO Certified 66 NEOPRENE

TYPE SO, UL APPROVED

How many conductors?
Bronco 66 Certified is made with from 5 to 60 conductors—more on special order—and carried in stock in nation-wide company warehouses.

What A.W.G. size?
Bronco 66 Certified ranges from size 18 through 4.

*Highest Neoprene content!*
Bronco 66 is a true Type SO, oil-resistant cable, the only portable control cable to bear UL approval. Outer protecting jacket is certified by a Registered Professional Engineer to contain not less than 67.32% Neoprene—*highest content in the industry!*

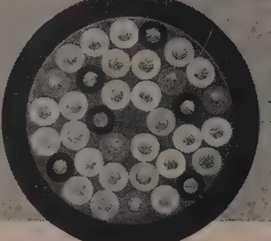
*Patented Branding!**
Molded* permanently into the jacket are "Bronco 66 Certified," type, size, number of conductors, rated voltage. With data repeated every two feet exactly, cable is self-measuring.

*Want real flexibility?*
You get a degree of flexibility that can't be equalled because only Bronco 66 Portable Control Cable is Synchro-Cured, fine stranded, electrically annealed for maximum flex life.

*Also stationary control cables and shielded control cables*

*U.S. Patent No. 2867001

WRITE FOR NEW FREE CONTROL CABLE FOLDER



WESTERN INSULATED WIRE CO.
Los Angeles 58, California

**ELECTRICIAN** for Kassay Bros. Inc. demonstrates the operation of their gas-driven concrete saw. Worm wheel in electrician's right hand raises and lowers cutting blade. His left hand is on the lever used to engage the clutch and provide forward motion of the machine. Diamond-tipped cutting blades are water-cooled. Unit paid for itself on one job, and now provides electrical contractor with a rental income, plus a low cost operation on other concrete cutting jobs.

quired a number of places as to the availability of a power-driven concrete saw on a rental basis. Unable to find a rental, he looked into the feasibility of purchasing a concrete saw. To his surprise he was able to purchase a new concrete saw, hire two laborers and two cement finishers, and with the use of two of his own electricians to operate the saw, do the entire job for less than the lowest sub bid.

Government specifications for cutting and patching the concrete runway were strict, and only a short time could be allotted to shut down the runway for the work. The first stage of the operation was to make the cuts in the concrete with the gas-driven concrete saw.

The concrete to be cut was 8-in. thick, and because the concrete contained blue stone, it was decided to make cuts about 3½ in. to preserve the blade and speed up the operation. Diamond-tipped blades used with concrete saws must be continuously cooled with running water. To solve this problem Kassay equipped one of his pickup trucks with a water tank and attached the water supply to the saw with a hose. Then as one electrician operated the saw, another electrician followed behind with the truck and water supply. A guide pointer, attached to the saw, followed a guide string, which was stretched across the runway. Two cuts, 24 in. apart, were made at two different areas of the runway.

# EXECUTONE EXTRAS

## help you bid profitably on intercom and sound systems

In today's big market for sound and intercom, Executone equipment is known for *highest standards of performance*. Hundreds of contractors are *also* discovering that they can put in a reputation-building Executone system at *lowest installed cost*. Here's why:

- **MINIMUM FIELD ASSEMBLY** Executone equipment is engineered for minimum assembly time on the job to meet contractors' field-installation problems. Most equipment comes completely assembled . . . components have plug-in terminal blocks. Hook-up time is cut to a bare minimum.
- **COMPLETE CO-ORDINATED SYSTEMS** You get everything you need from one responsible source . . . proven equipment, wire specifically designed and color-coded for the system. One-source responsibility cuts paper-work, delays, confusion.

**EXPERT PRE-PLANNING** Without obligation, your local Executone distributor will provide you with the services of an experienced systems engineer . . . to help in analyzing a project's needs . . . planning the required system with greatest installation economy . . . preparing bids and estimates.

- **INSTALLATION ASSISTANCE** An expert Executone field engineer is available to supervise every job. He helps you get in and out fast . . . assures you of proper hook-up, adjustment of the system and check out.
- **NO SERVICE CALL-BACKS** When you turn over the completed installation, Executone takes immediate responsibility for the proper operation of the system. The factory and the local Executone distributor give your customer unmatched guarantees and service on the premises.

Start building profits the Executone way. Check the coupon below for information on Executone sound and communication equipment for selected building types. We'll also send you a convenient Conduit Selection Chart to help you cut costs in layout and installation.

**Executone**
COMMUNICATION and SOUND SYSTEMS

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Dept. P-3, 415 Lexington Avenue, New York 17, N. Y.
Send me your Conduit, Wire and Cable Chart. Also:
information on Executone equipment for
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☐ retail stores ☐ homes ☐ ____________

Name________________ Title________
Company________________
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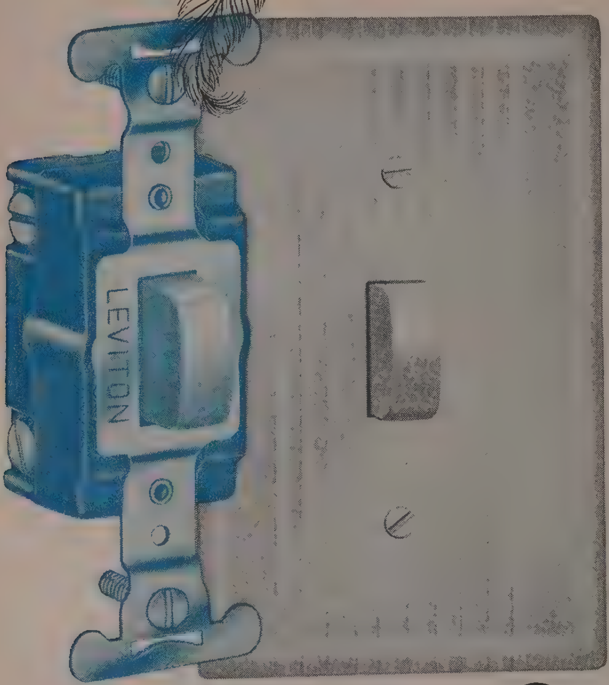
In Canada: 331 Bartlett Avenue, Toronto

*a gentle tap...*
**and you'll never settle for ordinary switches again!**



LEVITON A.C.
**TOUCH SWITCH**

Installs in any position...small enough to fit any gem box and standard wall plate ...and notice that quiet, "love tap" operation! Leviton's new 15A—120-277V. AC Touch Switch is a natural for homes, schools, apartments, office buildings, hospitals, industrial plants... anywhere! Tap it from any position, any angle!

CHECK THESE SPECIAL FEATURES:

**SAFE OPERATION**—install vertically, horizontally or upside down, yet a gentle tap gives positive, non-stalling action. Can't hang up...in any position. Special heavy silver contact points increase safety margin, prolong service life.

**EASY INSTALLATION**—side wired for convenience. Only 1" in depth. Large head brass terminal screws, backed out and staked, accommodate up to No. 10 conductors. Mounting screws are locked in straps ready-to-install. Interchangeable with any standard switch and wall plate.

**HIGH CAPACITY**—will accommodate high inductive loads of fluorescent systems, or full rated capacity of incandescent filament lamp loads. Take full load currents up to 80% of the switch rating for motor control.

**RUGGED CONSTRUCTION**—simplified construction and advanced design assure maximum efficiency, long life under heavy duty use . Heavy gauge steel plaster ear straps are riveted to housing for permanent assembly.

Creatively engineered and subjected to exhaustive "in-use" tests, Leviton AC Quiet Switches have proven themselves ideal for the new 4-wire electrical systems requiring switches rated at 277 volts. Available with brown or ivory button.

Listed by Underwriters' Laboratories, Inc. For complete details write to:

Your best jobs are done with... **LEVITON**

**Leviton Manufacturing Co** Brooklyn 22, New York • Chicago • Los Angeles • Leviton (Canada) Ltd., Montreal.
For your wire needs, contact our subsidiary AMERICAN INSULATED WIRE CORP. Pawtucket, R. I.

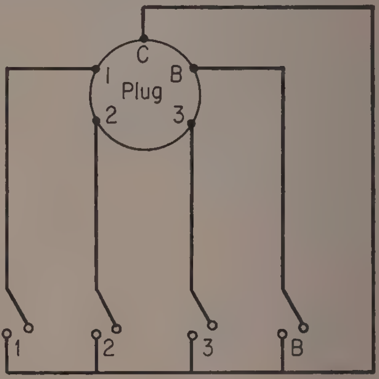
After the cuts were made, a pneumatic hammer was used to break through the remaining 5-in. of concrete and break the concrete up into chunks. Concrete pieces were then loaded into a truck and discarded.

Next, a scoop shovel was used to remove dirt to a depth of 4 ft. After this, electricians laid four 4-in. Transite ducts in two tiers. Ducts were supported and separated on 1-in. plastic spacers. Then about 1 ft of concrete was poured to encase the ducts. Following this, 2 ft of dirt backfill was added and tamped. Cement finishers completed the final stage of the project by adding 8 in. of concrete to match the existing runway surface.

Since this job, Kassay has had occasion to use his power saw on two other concrete cutting jobs. Another added feature is that they now rent the machine to masonry contractors and other electrical firms at the rate of $20 per day.

## Testing Devices For Hospital Signals

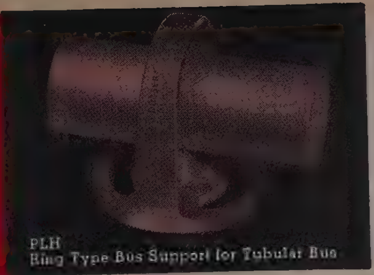
Testing out a hospital signal system was reduced to a quick and sure task by M. L. Monson, super-



KEY
1=Lights utility pilot light
2=Lights nurses station light and corridor light
3=Lights bedside light
B=Operates buzzer
C=Common terminal

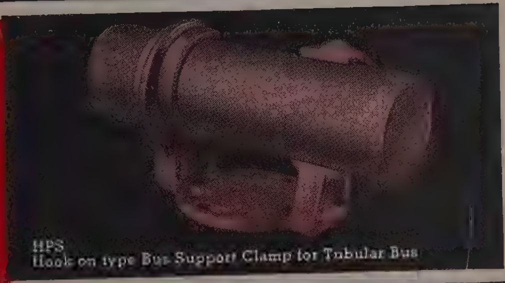
**FIG. 1**—The plug is connected to the four switches which are mounted on a panel. The connections are made as shown. The plug is inserted into the bedside receptacle with all the switches in the open position. Each circuit is tested by closing each switch. Switch B operates the buzzer at the station. When this switch is closed the buzzer should operate. If it does not operate, there is an open. If one of the lights goes on with this switch closed, the wires are reversed. Each circuit can be tested separately.

# RUGGED

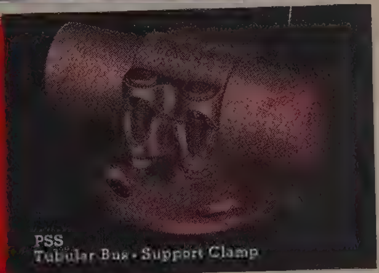

PLH
Ring Type Bus Support for Tubular Bus

SBC
Sliding Bus Support for Tubular Bus

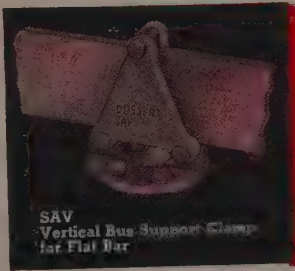
PSSQ
Bus Support for Square Tube


HPS
Hook on type Bus Support Clamp for Tubular Bus

CS
Bus Support Clamp for Cable


PSS
Tubular Bus - Support Clamp

SHV
Vertical Bus Support Clamp for Flat Bar


SAV
Vertical Bus Support Clamp for Flat Bar

# DOSSERT HIGH-STRENGTH BUS SUPPORTS

- Higher cantilever strength
- Higher impact resistance
- Higher corrosion resistance
- Greater durability

These Dossert Bus Supports are made of a high tensile strength cast bronze alloy and are equipped with silicon bronze bolts and nuts, making the entire unit completely non-magnetic. Available for all sizes and types of busses. Dossert Bus Supports can also be furnished in Coupling, Tee Connecting, Elbow Connecting, Tee Coupling and Expansion Connection types.

*Special fittings and modifications can be readily supplied on short notice.*

50
YEARS OF
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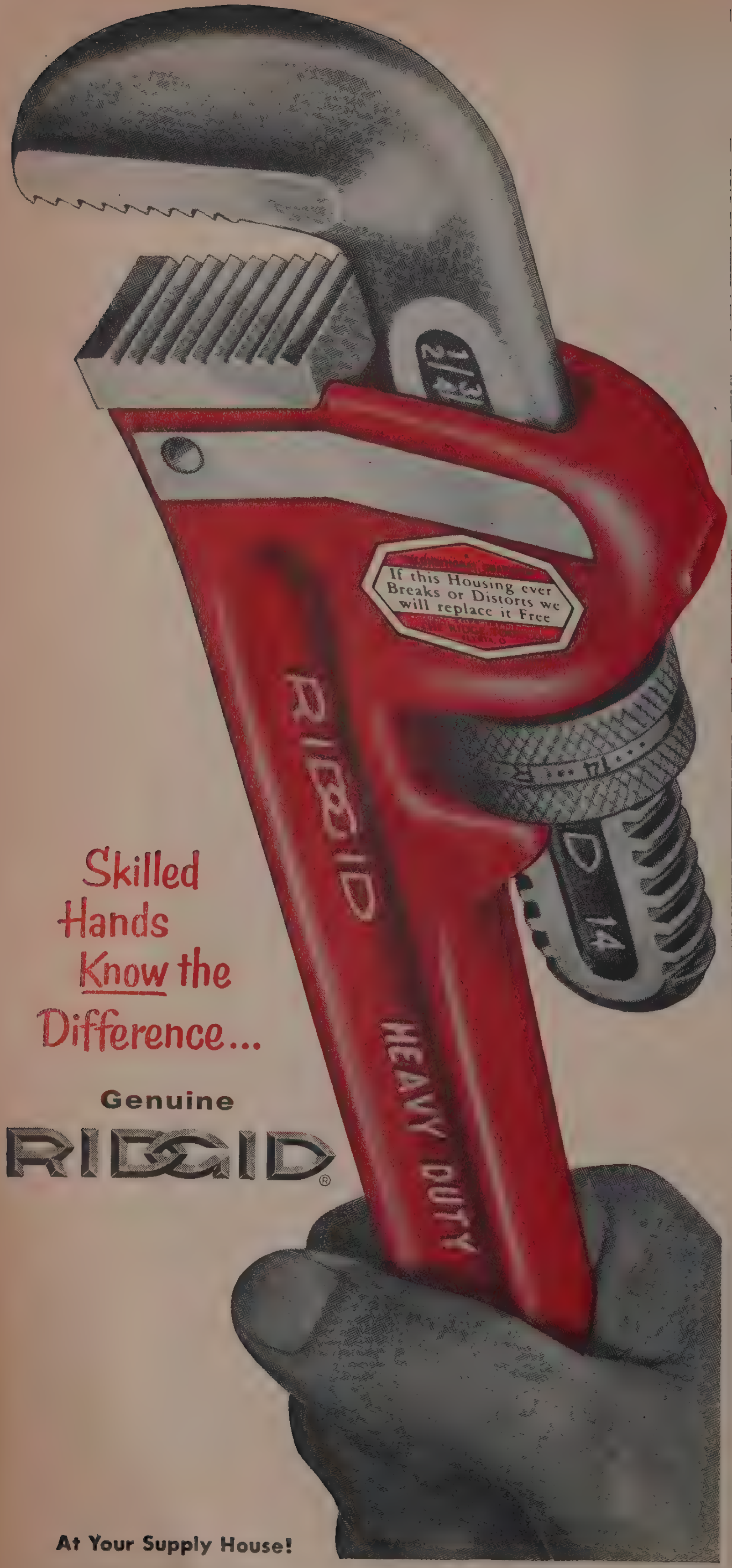
KNOW-HOW

**DOSSERT MFG. CORP.**
249 Huron Street, Brooklyn 22, N. Y. • Representatives in all principal cities
IN CANADA: W. S. Gerrie & Assoc., Ltd., Toronto



If this Housing ever Breaks or Distorts we will replace it Free
RIDGID
HEAVY DUTY
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Skilled Hands Know the Difference...

Genuine

RIDGID®

At Your Supply House!

**The Ridge Tool Company, Elyria, Ohio, U.S.A.**

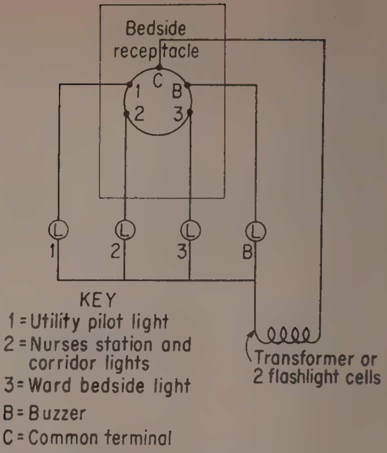


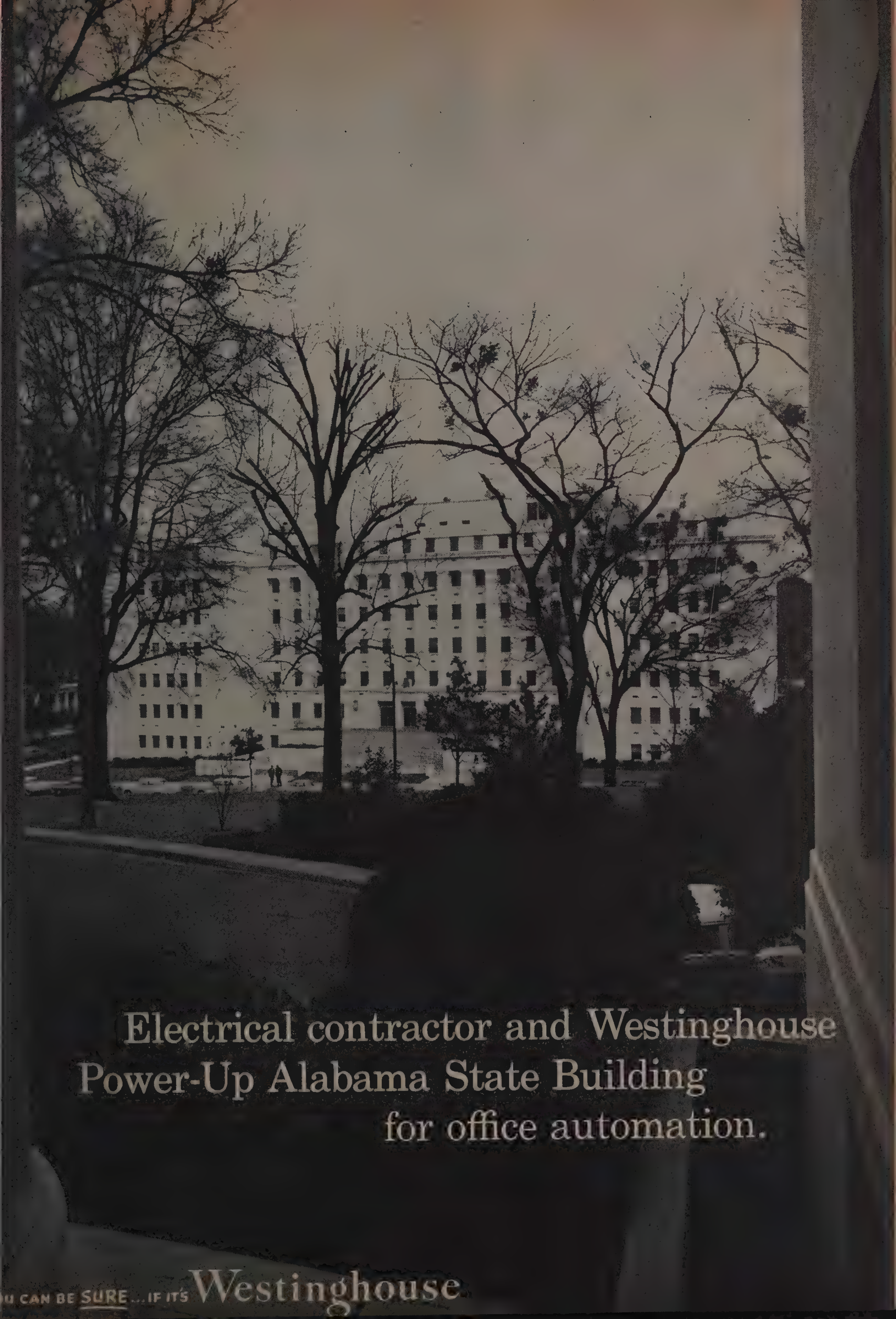
**FIG. 2**—When the signal cord which is to be tested is plugged into the receptacle, and the signal button is not depressed, the lights 1, 2, 3 and B should be dark. If one or more of the lights glow, there is a short in the cord or in the button. Upon depressing the button all the way, all of the lights will glow; and when the center button is released, and the rim button is in the locked position, lights 1, 2, and 3 should glow. The light B is the buzzer circuit and should light only upon depressing the center button. If any one of the lights does not glow when the rim button is depressed, it indicates that this portion of the circuit is open.

intendent of Municipal Utilities, Fosston, Minn. He built two simple devices to test wiring of bedside receptacles and wiring of the bedside cord in an Edwards' nurse-signal system. The two devices are combined in a single-panel assembly which is readily carried to the many points of testing. The units can save considerable time in locating incorrect wiring and connections to bedside receptacles.

The accompanying diagrams show hookup of the test devices. Fig. 1 shows the test plug and cord connected to four switches. This setup is used to check wiring from the bedside receptacle to the nurse station. Each switch tests a particular circuit of the system.

Fig. 2 shows the test receptacle and circuit used to check out the bedside cords which are to be connected to the bedside receptacles. By simply plugging in the cord to be tested and pressing the button, it is easy to determine whether or not the cord assembly is defective.

Basically, these test devices are simple and effective in assuring the quality of signal work as it goes in. From the installer's standpoint, there is no substitute for step-by-step checking in eliminating system troubles and expediting the overall job.


Electrical contractor and Westinghouse
Power-Up Alabama State Building
for office automation.
U CAN BE SURE ... IF IT'S Westinghouse

COVER PHOTO

Newest facade on Alabama's Capitol Hill is the seven-story, 258,500-square-foot State Administration Building shown on cover. The building houses 17 state agencies, will eventually be the "working home" for more than 1100 Alabamians.

New State Administration Building is geared for latest "office automation" techniques like data processing area *(at right)* which handles a steady flow of facts and figures. Westinghouse Type SC fluorescent luminaires, ceiling mounted for fast installation, provide an attractive and cheerful work area for state employes.

Teamwork paid off for the new Alabama State Administration Building. Careful evaluation of all building functions, sound planning and careful coordination produced a modern electrical distribution system—installed on time—that's ready to meet all present demands, anticipates future needs. Tandy Little, Jr. *(center)*, partner T. D. Little Electric Co., reviews specifications with O. E. Hatcher, Westinghouse Area Sales Manager; H. D. Mosley, Mosley and Yarbrough, Consulting Engineers; F. J. Sarknas, Westinghouse Construction Sales Engineer; R. F. Kirkpatrick, Sales Engineer, Moore-Handley Hardware Co.; and C. H. McCauley, Architect.

J-94141-2

# Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor

On the campus-like grounds around its gracious Capitol, the State of Alabama has erected a modern State Administration Building, reflecting Alabama's progressive outlook. In this newest addition to the Capitol buildings, data processing machines handle quarterly income tax notices, automobile registrations, numerous statistical reports, sales tax, etc. As many as 38 machines and other electrical equipment operate during one shift in one department alone . . . office automation that requires reliable power in large demands.

The electrical contractor, T. D. Little Electric Co., teamed up with consulting engineers, experienced Westinghouse engineers and the Westinghouse distributor to work closely with state officials, the architect and general contractor on system installation. Result: an electrical system carefully planned and executed to distribute efficiently the big power load . . . a system with expansion capability to keep the building modern for years to come . . . a system installed at a "saving" in direct comparison to other buildings on the "campus."

The electrical installation went off on schedule with building construction because of contractor-Westinghouse coordination and on-time deliveries by the Westinghouse distributor, Moore-Handley Hardware Co.

Westinghouse electrical equipment — reliable, adaptable and easy to install—was used throughout the building.

Included are a building-type switchboard, motor control center, distribution and lighting panelboards, low-impedance bus duct, circuit breakers, safety switches and fluorescent lighting. *(cont.)*

**YOU CAN BE SURE...IF IT'S Westinghouse**

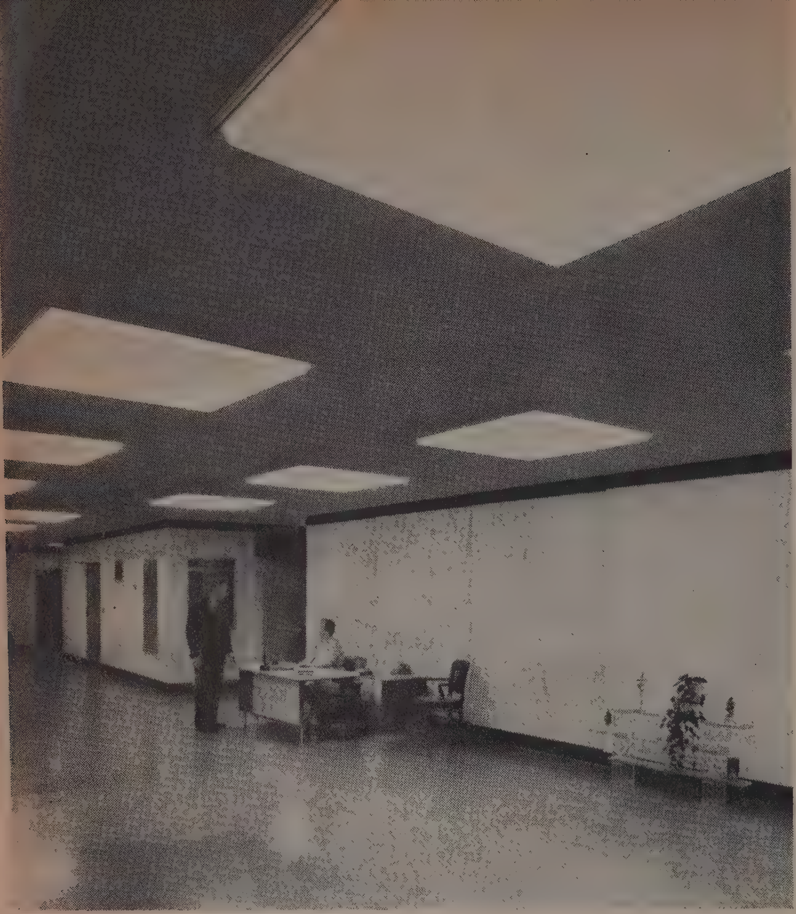
TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

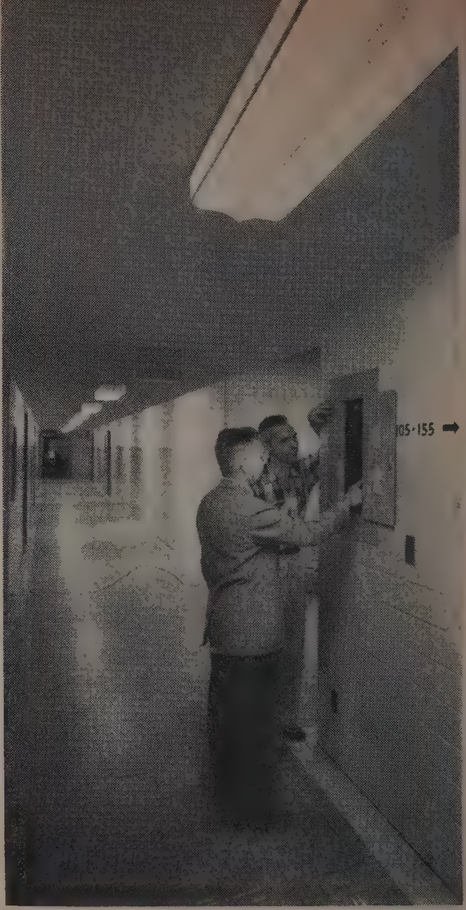
J-94141-3

A 120/208-volt Westinghouse building-type switchboard protects and distributes power to all floors. Note blank sections for future system growth. Ventilated low-impedance bus duct, rated 3000 amps, conducts incoming power to switchboard from a bank of three 250-kva, Type SL, oil-insulated transformers. Mills Cowling, Chief of Service Division, State of Alabama; W. C. Sparks, Vice President, Moore-Handley Hardware Co., Westinghouse Distributor; T. D. Little, Sr., T. D. Little Electric Co., Electrical Contractors; and F. J. Sarknas examine future expansion features designed into switchboard.

Exhaust fan, elevator, air conditioning compressor, water pump and air handling equipment motors are served by a 480-volt Westinghouse motor control center which consists of Class 11-206 motor starters. Motor control center receives power supply from transformer vault by 1350-amp, low-impedance bus duct with many time-saving installation features. H. D. Mosley; O. E. Hatcher; William Lawrence, Jr., Deputy Director of Technical Staff, Alabama Building Commission; and C. H. McCauley inspect compact, efficient installation.

Westinghouse 1000-amp low-impedance ventilated bus duct efficiently distributes power to Westinghouse Type CDP distribution panelboard from distant switchboard with minimum voltage drop. H. D. Mosley and H. H. Houk, Director of Technical Staff, Alabama Building Commission, check neat bus duct installation as C. H. McCauley and O. E. Hatcher review circuit breaker arrangements in panelboard.





Alabama marble and Westinghouse Mainliner fluorescent fixtures combine to form an attractive welcome for employes and visitors in new Alabama State Administration Building. Westinghouse Mainliner large area luminaires have universal ease of application with installation flexibility. *Above,* R. F. Kirkpatrick points out details of Westinghouse lighting panelboard, Type NLAB, 120/208 v, to G. D. Schnell, member of the maintenance staff. Circuit breaker panelboards provide maximum circuit protection for Westinghouse Type SC fluorescent lighting luminaires used in corridors.

## Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor *(cont.)*

Many outstanding electrical contractors have found Westinghouse equipment, coupled with localized Westinghouse service, the solution to power distribution system problems and a key way to increase installation efficiencies. Westinghouse can aid you in any phase of your electrical planning and construction. Call your Westinghouse distribution outlet or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94141-4

OWNER: State of Alabama
ARCHITECT: Charles H. McCauley, Birmingham, Ala.
CONSULTING ENGINEER: Mosley and Yarbrough, Montgomery, Ala.
GENERAL CONTRACTOR: A. C. Sanford, Albany, Ga.
ELECTRICAL CONTRACTOR: T. D. Little Electric Co., Montgomery, Ala.
WESTINGHOUSE DISTRIBUTOR: Moore-Handley Hardware Co., Birmingham, Ala.

YOU CAN BE SURE...IF IT'S Westinghouse

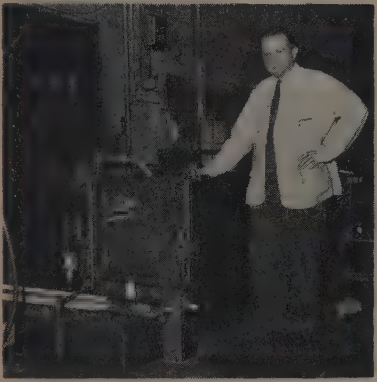
TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

Tandy Little, Jr., typifies progressive qualified electrical contractors who are helping America to Power-Up. He holds an electrical engineering degree and is president of Central Alabama Chapter of the National Electrical Contractors Association. A partner in T. D. Little Electric Co., he has responsibility for job management, contract negotiation, estimating and buying. His preplanning, business judgment and knowledge of currently available electrical products were big factors in the efficient electrification of the new Alabama government building.

# Utica Shop Offers Complete Motor Service

Complete sales and service for new and rebuilt equipment, including a well-equipped winding shop, have provided increased profits and customer satisfaction.

**STORAGE SHELVES** contain motors ready for use in the firm's emergency replacement service. Motors are tagged with frame and type designations, and bins are numbered to coincide with a master inventory list. As a result, available equipment can be located in a minute's notice.



**BILL DIEHL,** official of Mather, Evans and Diehl Co. Inc., Utica, N. Y., points to a new degreasing tank, which speeds up cleaning of motor and equipment parts that are in the shop for repair service.

THE FIRM of Mather, Evans and Diehl Co. Inc. of Utica, N. Y., started in the motor shop business in 1921. At that time they were a motor repair shop exclusively. Throughout the years of expanding their business, the firm added complete lines of new and rebuilt electrical equipment, and today they offer the largest complete motor and power transmission service in Central New York.

They are distributors for a number of major manufacturers of new motors, motor controllers in all NEMA sizes, dry-type transformers, circuit breakers, fuses, couplings, speed reducers, electric power tools, gear motors, and many other items which are necessary for complete motor and power transmission requirements.

Several full-time salesmen canvass the territory and offer new equipment, rebuilt equipment, and repair and service of equipment.

Over 25,000 sq ft of floor space contain a complete stock of the many electrical and mechanical lines handled by the firm.

In the repair end of their business they offer an emergency pick up service and rewind motors up to 200 hp. In their machine shop they are set up to make their own gears and other items requiring special machining.

The motor rewinding department is completely equipped and laid out to do the job quickly and efficiently. When a faulty motor is brought in, it is transported to the motor shop by a network of hoists. In the motor shop a crane track circles the room.

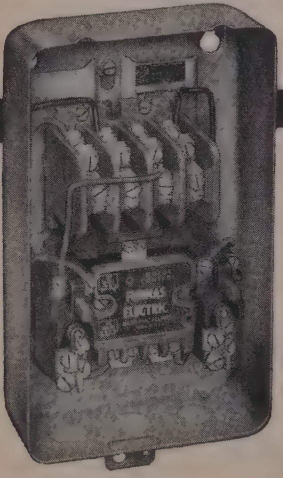
When a motor is hoisted from the first floor through a shaftway to the second floor motor shop, the circular track hoists take over, and the motor is on the way to the various processes of repair. Coil former, winder, dip tank and bake oven are located to coincide with the proper sequence of motor repair.

**SMALL MOTOR** parts are neatly arranged in sturdy, well-labeled bins and drawers. Stocks are kept up-to-date by an adequate inventory system, and new parts are added as new equipment models are produced. Over 25,000 sq ft of floor area has bins for complete motor and power transmission parts.

**COMPLETELY REBUILT** 150-hp wound rotor motor and its drum controller await delivery to the job. Crates of new equipment and steel-frame shelves with complete stocks of motor and power transmission parts are shown in the background.

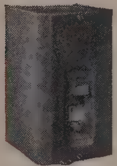
Here's Why...
YOU GET
Superior Performance
FROM
Furnas Controls

Furnas Electric Magnetic Starters feature advanced design to assure superior performance and longer life. Standardized design reduces inventory and allows a wider application with fewer components.



- Dual Voltage 110-220 or 220-440 Volt Coils reconnectable on the job. Magnet features just one moving part.
- Non-tracking Contact Block is impact resistant. Completely visible and front removable silver-cadmium oxide contacts.
- Trip-free Thermal Overload Relays—manual or automatic reset. Third overload relay kit can be added in the field.
- Extra Switchlet interlocks for additional pilot circuits (up to 4) may be added to all starter sizes 0-4.

PUSH BUTTON



MANUAL STARTER

CONTACTORS

DRUM CONTROL

Write today for FREE Color Bulletin 14-B1, Furnas Electric Company, 1067 McKee St., Batavia, Illinois A75

FURNAS
FURNAS ELECTRIC COMPANY
BATAVIA, ILLINOIS
Sales Representatives in All Principal Cities

**OVERHEAD ELECTRIC HOIST** is ready to pick up a wide variety of motors and carry them by an overhead track to the rear loading platform. A series of overhead tracks connect all phases of the operations of the Mather, Evans and Diehl Co. Inc. Large equipment can be moved quickly and efficiently.

**CIRCULAR HOIST TRACK** covers the entire perimeter of the winding department. Various stages of motor repair are set up in logical sequence below the hoistway, and the operation speeds up repairs and reduces labor costs.

Latest equipment added to the repair department is a new degreaser, shown in an accompanying photo, which cuts the grease and dirt from motor parts.

Supplies and equipment are neatly stacked in sturdy steel frame shelves. Bins and shelves are marked with numbers, which speed up delivery and simplify inventory. With hundreds of parts and motors of various frame sizes and ratings, it takes but a minute to locate any device.

Another plus factor for a good inventory system is that customers are not delayed at the counter or on the phone. When a customer requests a specific item, he is quickly informed if it is in stock.

Officials of Mather, Evans and Diehl are proud of the complete motor repair and sales and service

Tube mill operator here keeps close watch as he adjusts weld heat on control console.

*Contractors find:*

**CIRTUBE*EMT maintains uniform high quality**

KNOWING that the EMT you use is always of the same high quality—from tube to tube, bundle to bundle, and month to month—is one sure way to help guarantee better electrical jobs at lower installation costs.

CIRTUBE EMT is like that. Made in a brand new plant, with ultra modern equipment, the latest techniques, and the most stringent quality control measures that experienced engineers can devise, CIRTUBE EMT has already acquired a reputation for unsurpassed uniform quality and workability.

*Uniform, high quality* is only one of many reasons why CIRTUBE EMT helps get better, more profitable wiring jobs.

Why don't *you* try CIRTUBE EMT on your next job — you'll like working with it. Now at your Circle wholesaler's.

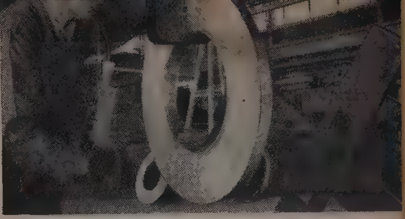
*Trade Mark

**CIRCLE** WIRE & CABLE
*a subsidiary of*
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: In all principal cities

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

CIRTUBE EMT *Ask for it!*

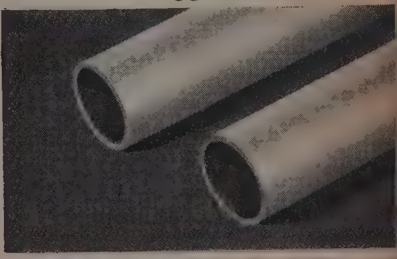


***Proper steel plus!*** The best cold rolled steel plus the right handling give CIRTUBE EMT its natural bendability.

***Split-free, bead-free!*** Induction welded CIRTUBE EMT, left, proves stronger than ordinary EMT, provides easier fishing.

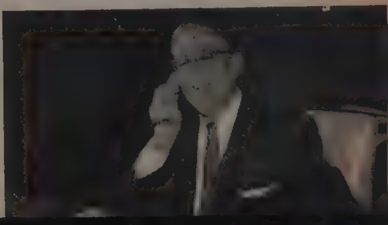
***Easy fishing!*** A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.

***Lifetime exterior finish!*** Hard galvanized finish for durability; polished satin lustre for lasting good looks.



***Tight, easily handled bundles!*** Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

***Fast, friendly service!*** Well-known Circle service through a nation-wide network of well stocked nearby warehouses.

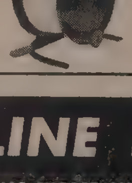


Wire conduit the **JET LINE** way

OWN THE COMPLETE JET LINE METHOD:

Jet Line Power Cylinder — for 1/2", 3/4", 1" conduit

Jet Line Gun — for conduits 1 1/4" to 6"


Jet Line Poly Rope — lightweight, strong, flexible, non-conductor

You can pull wire in minutes instead of hours using the Jet Line Method*. Contractors everywhere are doing it, and saving up to $40 per day or 70% of wire-pulling costs!

The Jet Line Method — Gun, Cylinder, and Poly Rope — provide the fastest, easiest, safest means of wiring conduit ever invented. Ask your wholesaler for a demonstration, and see for yourself how you can make money by saving countless hours on wire-pulling jobs... with Jet Line. Low-cost Starter Kits available.

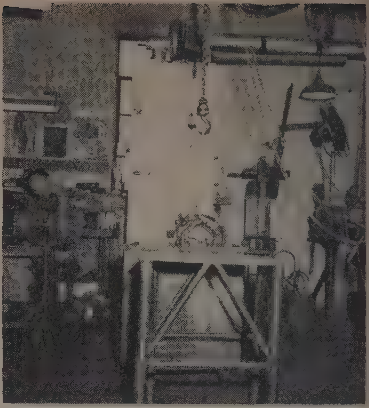
*Pat. #2,930,584

4819

*Ask your distributor for details, or write*

**JET LINE PRODUCTS, INC.**

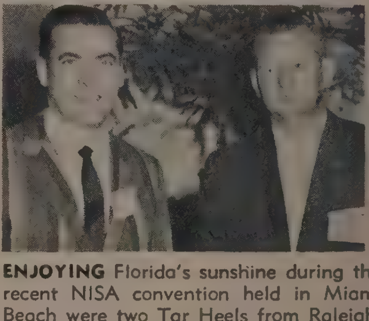
615 FUGATE AVE., CHARLOTTE 5, NORTH CAROLINA



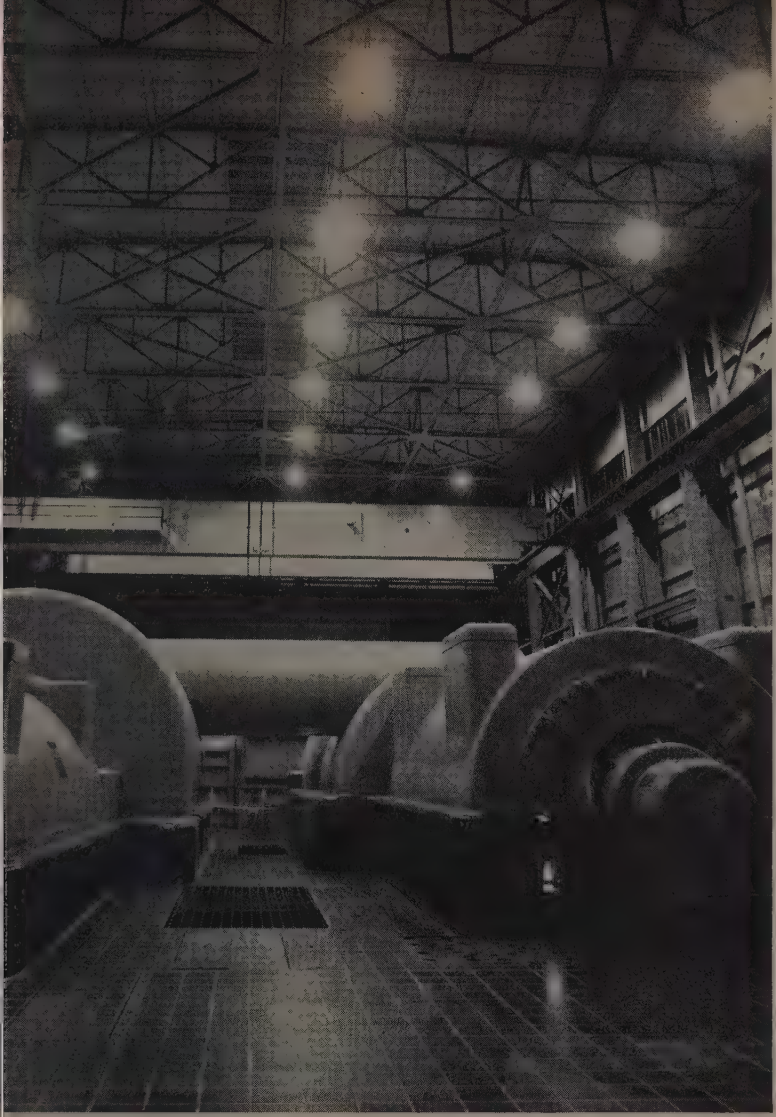
**MOTOR STATOR** has just been raised from the dip tank and will be placed in the electric baking oven directly behind the dip tank. Mechanic in left background is overhauling a water pump.

**MATHER, EVANS AND DIEHL** mechanic removes new form-wound coil from their forming machine. Forming machine is in the center of motor winding department in proper sequence with the rest of their production line assembly for rewinding motors.

that they have to offer. Complete customer service has paid off because customers prefer dealing with a firm that can offer new sales, service and repair for all motor and power transmission requirements.



**ENJOYING** Florida's sunshine during the recent NISA convention held in Miami Beach were two Tar Heels from Raleigh, N. C.,—William S. "Bill" Ward (left), and W. P. Chapman, both of Electrical Motor & Repair Company.



*Twenty-four 1000w color-corrected mercury lamps, spaced on 20 x 30 ft. centers, are mounted 50 ft., 6 in. above floor. Maintained illumination is 30 footcandles.* Installation — *Metropolitan Edison Co., Reading, Pa., Portland Station.* Electrical Contractor—*H. N. Crowder Co.,* Engineers and Consultants—*Gilbert Associates, Inc.*

*Sola transformer No. 77020 maintains rated lumen output of H15 lamp in Holophane fixture within ±1% even if primary voltage should vary over 200 to 260v range.*

*Newest line of indoor Sola constant-wattage mercury-lamp transformers features light weight, improved case construction; starts mercury lamps down to 20° below zero.*

# Sola-ballasted mercury lamps specified for new generating station

Here are five performance benefits that make Sola constant-wattage transformers pay off in modern mercury lighting installations: Light output is constant within ±1% with line voltage changes as great at ±13%. Line-current starting surge is limited to normal operating value—eliminates need for heavier wiring, time-delay relays. The constant-wattage circuit limits primary current under abnormal conditions—lamp failure or secondary short circuit will not overheat the transformer. Stable operating conditions insure rated lamp life. Line voltage must dip 30% below nominal before lamps extinguish.

The utility's engineers and consultants recognized these benefits and specified constant-wattage transformers. Consult your Sola lighting representative for further information, or write for Bulletin MV-396.

**SOLA**

**SOLA ELECTRIC CO.**

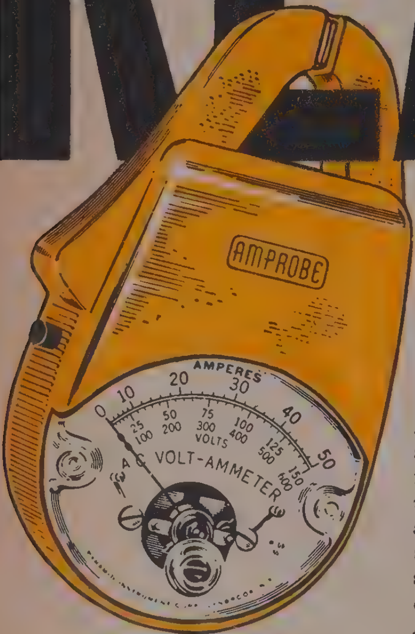
B P C

**A Division of Basic Products Corporation**

4633 West 16th Street Chicago 50, Illinois

*TRADE IN YOUR OLD VOLTAGE TESTER!

READ



voltage
and amperage
in a snap!

A voltage "indication" doesn't give you all the information you need to do a job right. You want a precise voltage *reading*, measured on a calibrated scale... and you get it with the AMPROBE JR. But sometimes voltage is only half the story. Most jobs require an accurate *current* reading too. The pocket-size AMPROBE JR. provides it – in a snap – *without* interrupting service! Why settle for anything less?

*SPECIAL OFFER

Trade up to an AMPROBE JR. *now*. For a limited time only, we'll give you a sturdy leather case plus the AMPROBE ENERGIZER (to multiply the JR.'s sensitivity *ten times*)—an *$8 value*—for *only $1* and your obsolete voltage tester! The leads come with the JR. Snap up this offer today—at your distributor.

**Amprobe Jr.**
snap-around volt-amp tester
$19.85

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK
*Serving the Electrical Testing Needs of Industry*

## ELECTRICAL SYSTEM RELIABILITY

[FROM PAGE 87]

withdrawn. Each switchgear cell has in it an auxiliary switch that automatically transfers control of the air circuit breaker to the proper location in accord with the position of the breaker in the cell. Thus when the breaker is in the "in operation" position, its control is switched to the master control board and only emergency tripping is possible from the switchgear itself. When the breaker is withdrawn to the "test position," its control is switched away from the master control board and to a local control station on each switchgear cell. In this "test position" the load voltage contacts of the breaker are disconnected and grounded, but the secondary control contacts can be energized and the operation of the breaker checked. When the breakers are "withdrawn," they can be moved to a test panel and connected for a complete operation test and have any repairs or adjustments made that might be necessary.

The vent fan motor starter units are provided with two full length doors, each which normally enclose the units into dead-front-type of construction. Opening of these doors provide full access for maintenance and repairs to all of the vent fan motor and auxiliary contactors and relays.

The master control board is also of the dead-front-type construction, with full length doors all across the back for easy access to all devices and connections. The alarm panels on the master control board employ a "test switch" to check the conditions of each alarm circuit, and each alarm circuit consists of "plug in" relay units for ease of replacement in case of trouble.

The electrical system as well as the entire bridge, tunnel and approach highway system was designed by the consulting engineers —Parsons, Brinckerhoff, Quade and Douglas for the Virginia Department of Highways. The general contractor for the first phase—tunnel and bridge construction—was Merritt Chapman and Scott, Inc. For the second phase—vent building, roadways, equipment, and interior finishing—the general contractor was Tidewater Construction Corp. The electrical installation was made by E. C. Ernst, Inc.

# The men who really know...know Efcor

Meet Bill Reynolds, a man with his head in the clouds and his feet planted firmly on the ground. Electrical General Foreman for Fischbach & Moore Inc. and L. K. Comstock & Co., a joint venture, Bill has over 33 years of skyscraper construction experience behind him. Ask Bill about electrical fittings and boxes and he'll tell you he's always glad to hear that Efcor's on the job. That's his assurance of products manufactured with the engineering, the quality and the features that mean greater efficiency and a better job done for Bill and his men. Like Bill Reynolds, all across the country you'll find the men who really know . . . know EFCOR.

Efcor

**ELECTRICAL FITTINGS CORPORATION · WOODSIDE 77, N.Y.**

**Mr. Lester C. Breitzman, Assistant Fire Marshal, Bureau of Fire Prevention, Evanston, Illinois, says:**

# "This automatic fire meets every requirement

Assistant Fire Marshal Breitzman at the central fire alarm panel, located just inside the main entrance. A fire in any of the three Washington National Buildings will sound an alarm here, and cause a light to flash, indicating the exact floor and building. Firemen can thus pinpoint the trouble-spot immediately.

# detection and alarm system of our safety code."

WASHINGTON NATIONAL INSURANCE BUILDING, EVANSTON, ILLINOIS

*Architect-Engineer: Graham Anderson, Probst and White, Chicago*
*General Contractor: A. L. Jackson Company, Chicago*
*Electrical Contractor: Hyre Electric, Chicago*
*Mechanical Contractor: Carrier Corp., Chicago*

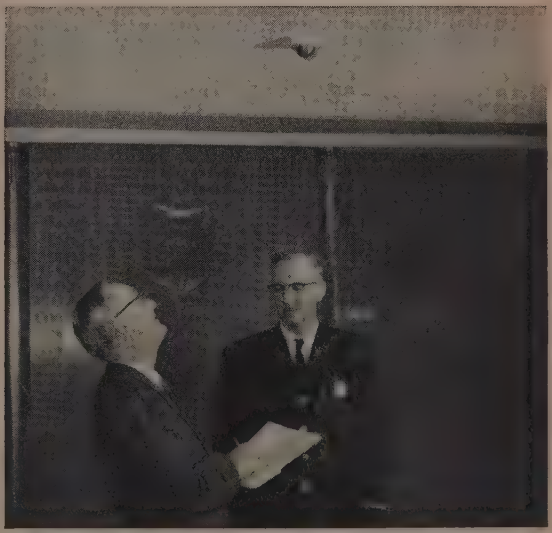
## The Washington National Insurance Building is protected by a Honeywell system that detects fire and sounds an alarm in the building and at the Fire Department.

"This type of fire protection system is ideal for an insurance company," says Chief Breitzman. "Detectors located throughout the building will automatically detect a fire and ring alarms in the building and at our fire station. And it provides *continuous* protection. The 552 detectors installed here function as 552 watchmen, on 24-hour duty."

Chief Breitzman was consulted during the location of the automatic detectors in the Washington National Insurance Building. The building also has manual pull stations for double protection. Either will sound the alarm and indicate the location of the fire on a panel in the lobby and at the central control console in the Chief Engineer's office.

The system is so foolproof, it will trip the alarm even with a ground or a break in both wires of the detecting loop. A standby battery makes sure the alarm will go off even during a power interruption. The components of the system are listed by U.L. and backed by fast, efficient Honeywell service.

Honeywell's complete line of automatic fire detection and alarm systems will meet the most rigid fire safety codes. For additional information, call your nearby Honeywell office. Or write Honeywell, Dept. EC-7-76, Minneapolis 8, Minnesota.



Mr. Clifford Fohr, Second Vice-President of Washington National, and Marshal Breitzman discuss a fire detector in the main lobby. Breitzman explains that the detector can sense a fire as much as 25 feet away.

**Honeywell**

*First in Control*

H HONEYWELL SINCE 1885

75th YEAR PIONEERING THE FUTURE

# THE MARK OF SORGEL

DRY-TYPE TRANSFORMERS • SPECIAL TRANSFORMERS
SORGEL ELECTRIC CO.
QUIET QUALITY
MILWAUKEE, WISCONSIN
INDOOR UNIT SUBSTATIONS • D. C. SATURABLE REACTORS

## your guarantee of the preferred

# DRY-TYPE TRANSFORMERS

Look for the gold seal on dry-type transformers. It is the true mark of creative engineering and manufacturing craftsmanship. It represents the choice of a Consulting Engineer who specified the best; a Plant Engineer who wanted to be assured of dependability, rugged construction, high efficiency, a full-rated load operating continuously at a safe temperature; a Wholesaler who recommended for performance first; a Contractor who insisted on guaranteed delivery, installation ease, versatility of application, plus a competitive price; and a satisfied customer who is enjoying the great operating economies found only in Sorgel's expertly designed, carefully constructed, sound-rated, dry-type transformers. Complete engineering data and design services are available from your experienced, local Sorgel Sales Engineer, or from Sorgel's sales headquarters in Milwaukee.

*Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts, Including Special Transformers and Saturable Reactors*

## SORGEL ELECTRIC COMPANY

**836 West National Ave., Milwaukee 4, Wisconsin**

**Sales engineers in principal cities.** ***Consult the classified section of your telephone directory or communicate with our factory.***

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# CATALOGS, BULLETINS
# ADVERTISEMENTS

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**PRODUCT NEWS, PRODUCT BRIEFS:**

Use first line of boxes. Insert item numbers of products on which more information is desired.

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Use second line of boxes. Insert item numbers of literature desired.

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Please send me without obligation further information about the following: 7/60

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Advertisement on Page

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

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COMPANY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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# NEW PRODUCTS
# CATALOGS, BULLETINS
# ADVERTISEMENTS

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**Regulator** (1)

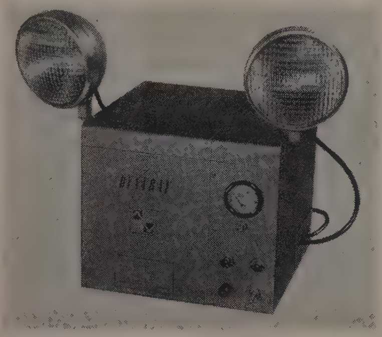
New Solamatic line of static-magnetic voltage regulators is designed for 3-phase circuits from 50 kva to 2000 kva. The line is capable of serving very large machines, or entire bays or departments of commercial or industrial plants. Units automatically and continuously deliver output voltage controlled within plus or minus 1% under line voltage variations as great as plus or minus 10%. Response time is 1.5 cycles or less. Solamatic can be furnished as a step-up or step-down isolating transformer. Unit is self-contained, transformer-type device. Units are for 3-phase input voltages ranging from 600-volt class to 15-kv class.

*Sola Electric Co.,* 4633 *West* 16*th St., Chicago* 50, *Ill.*

**Lighting Control** (2)

The Lamplighter, Series 15,000, a photoelectric lighting control, has an injection-molded plastic cover and base to provide high dielectric strength. A series of exterior ridges makes handling easier and facilitates installation, while a twist-lock base, conforming to EEI-NEMA standards, fits all standard receptacles. Light level, adjustable externally from the base, can be set from 1 to 10 footcandles, depending upon requirements. To prevent turn-off from light sources such as lightning and automobile headlights, control has a time delay feature. Should control fail, light will remain on.

*Acme Wire Company, New Haven* 14, *Conn.*



**Emergency Lighting** (3)

A new completely automatic 6-volt nickel-cadmium battery unit for emergency lighting, called Dynaray DR402T, can be used in practically any installation employing artificial lighting. It is UL listed. Charging circuits and battery voltage are monitored by a transistor. Charging rates are fully automatic when ac is applied. The whole process of recharging from complete discharge to full charge takes 12 hours, then switches automatically to low-rate trickle charge, thus maintaining full power constantly. Visible meter indicates battery voltage at any given time. 1960 Dynaray catalog is available.

*Electro Powerpacs, Inc.,* 5 *Hadley St., Cambridge* 40, *Mass.*

**Tape** (4)

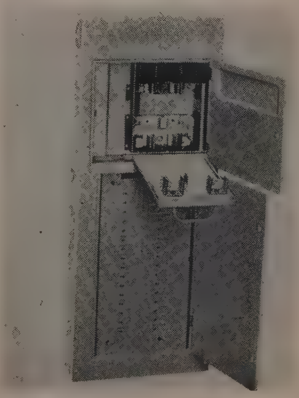
A new semi-cured, permafil-treated glass cloth that can be applied to coils and cured without pressure has been announced. Rated for Class B operation, tape is available in thicknesses of from .005 to .011 in. Tape is designed primarily for use on motor armature or field coils, but also can be used to tie down field coils and band armatures and exposed end of commutator cones. In addition, tape can be used in the manufacture of laminates and molded forms such as coil spools, terminal boards, and relay covers.

*General Electric Co., Schenectady* 5, *N. Y.*

**Transformer** (5)

A new 15-kv molded outdoor current transformer, Type CTOM-15, is available in current ratings of 10/5 through 800/5 amps. New unit replaces the steel-fabricated Type CTO. With its 1.5 rating factor through 600 amps it has 50% more overload capacity. A large removable conduit box permits easy and quick connections and change outs due to increased load.

*Westinghouse Electric Corp., P. O. Box* 2099, *Pittsburgh* 30, *Pa.*



**Enclosure** (6)

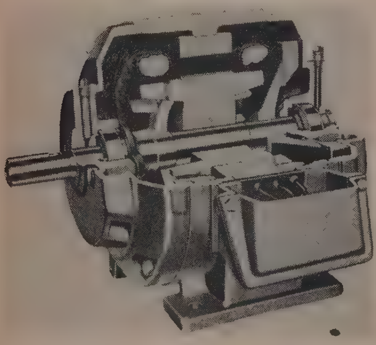
New 200-amp fusible main has provisions for 24, 32 or 40 circuits in non-interchangeable enclosure. It will fit between studs set 16 in. on center. It is for 3-wire service, solid neutral, 120/240 volts ac. Cabinet is available in either surface or flush mounting with dead-front construction also for indoor and raintight installations. It is listed by UL.

*Wadsworth Electric Mfg. Co., Inc., Covington, Ky.*

### Trencher (7)

Equipped with its own backfill blade, the 1960 Davis T-66 trencher can be raised or lowered hydraulically and can be set straight or angled to the left by a simple pin setting. This 37-in. wide rig passes through yard gates, offers two-speed gear reduction: low for creeping and high for dozing or transport. Independent drive clutches and disc steering brakes are provided for each track. Digging to 66-in. depths is possible in 3- to 4-in. widths. At a foot wide, the trencher goes to 30 in. deep, and at varying widths and depths in between. Hydraulically operated standard boom telescopes from 26 to 40 in. for digging to a 40-in. maximum depth. With an extra equipment telescoping extension, rig is adjustable for the 54- to 66-in. depth.

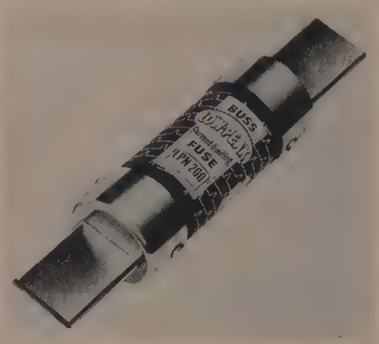
*Davis Mfg. Inc.,* 1500 *McLean Blvd., Wichita, Kansas*



### Motors (8)

A new line of open weatherproof ac motors with an epoxy encapsulated insulation system, called Duty Master weatherproof motors. They are currently available in frames 180 through 445U (1 through 125 hp) in all standard speeds and voltages. Stator windings are encapsulated in a specially formulated epoxy resin for resistance to moisture, oils, dust, chemicals, acids and alkalies. The full Class "B" insulation system is built around the thixotropic epoxy resin which is applied by a vacuum impregnation process. The system employs polyester round copper magnetic coil wire, epoxy-insulated glass-fibre sleeving, epoxy-treated glass-fibre cloth slot liners and phase insulation. Separators and top sticks are glass mat base epoxy resin laminate, and lead cable is protected by moisture-proof silicone rubber. The insulation system uniformly coats motor windings to permit heat dissipation, while producing high resistive properties, flexibility and bond strength. Cast-iron conduit box is diagonally split with a gasketed cover for access to leads. A neoprene gasket between motor housing and conduit box holds numbered leads by means of knobs.

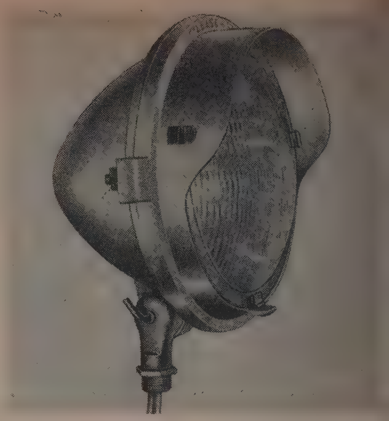
*Reliance Electric and Engineering Co.,* 24701 *Euclid Ave., Cleveland* 17, *Ohio.*



### Fuse (9)

High interrupting capacity fuse with long time-lag and current-limitation, called Low-Peak fuse, is available. Circuits can be fused close to their normal current load, and motor-starting currents or other harmless overloads will not cause the fuse to blow. Yet, on heavy fault currents, the fuse opens so rapidly the fault current cannot build up to a damaging peak. Let-thru current is restricted to safe values, protecting circuit components against thermal and mechanical stresses. Fuses fit standard switches and panelboards. Available from 15 to 600 amps in both 250- and 600-volt ranges. Applications for this fuse include providing individual burnout protection to motors, solenoids or transformers as well as giving overload and short-circuit protection to circuit conductors.

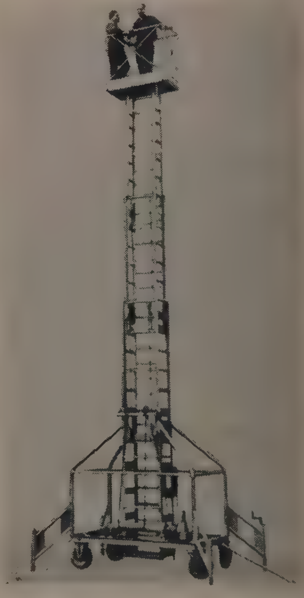
*Bussmann Mfg. Division, McGraw-Edison Co., University at Jefferson, St. Louis* 7, *Mo.*



### Lamp Holder (10)

A new, all-weather holder designed to accommodate PAR-64 500-watt lamps provides trouble-free operation under the most severe conditions. This SSNB series holder has a sturdy visor for better lens protection. Base of knuckle mounting has ¾-in. thread, which is notched to prevent loosening when holder is used in high vibration areas.

*Killark Electric Manufacturing Co.,* 3940 *Easton Ave., St. Louis* 13, *Mo.*



### Mobile Platform (11)

New mobile work platform is mounted on a trailer built for tough road conditions, resulting in a platform that can be rolled over the toughest terrain where overhead maintenance is a problem. It is a one piece unit and comes ready for work. Unit may be used at any desired height.

*Atlas Industrial Corp.,* 849-39*th St., Brooklyn* 32, *N. Y.*

# ANNOUNCEMENT!

# LINE MATERIAL now takes another great forward step in broadening its service to electrical contractors through electrical wholesalers

Many new opportunities for commercial, industrial, and residential outdoor lighting sales are developing for electrical contractors. These include industrial plants, shopping centers, subdivisions, swimming pools, hotels and motel grounds, drive-ins, amusement areas, parks, estates, and residential areas.

To serve this growing market better, Line Material is expanding and clarifying its already friendly relations with electrical contractors. To serve these contractors better, L-M is expanding its distributor organization with a new program of L-M facilities and services for distributors, and a clear statement of policy.

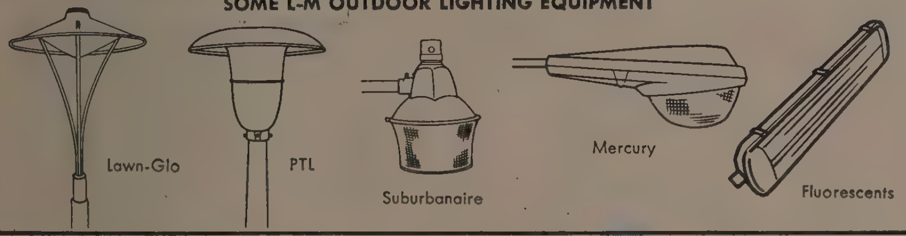
L-M feels that this new program will provide you with more L-M service through your distributor, and will increase your business and profit by permitting you to take advantage of this vast growing market for outdoor lighting.

Ask your distributor. If he is not already an Authorized L-M Distributor, ask him to get in touch with us. Or, if you prefer, mail the coupon.

## Offers The Distributor:

- ✓ *A complete line of high quality outdoor lighting products.*
- ✓ *Markets exclusively reserved for Authorized L-M Distributors.*
- ✓ *Technical information for Authorized L-M Distributors.*
- ✓ *Outstanding Application Engineering Service.*
- ✓ *Extensive national advertising and promotion.*
- ✓ *Product promotion for architects and consulting engineers.*

**SOME L-M OUTDOOR LIGHTING EQUIPMENT**



**LINE MATERIAL® Industries**

463

McGRAW-EDISON COMPANY

**Outdoor Lighting**

MORE THAN 10,000 PRODUCTS
FOR OUTDOOR LIGHTING AND POWER DISTRIBUTION

McGRAW EDISON

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**Line Material Industries, Lighting**
**Division, Milwaukee 1, Wisconsin**

ECM70

☐ Please send me Bulletin on L-M Outdoor Lighting

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Title____________________

Company____________________

Address____________________

City________________State________

My Electrical Wholesaler is____________________

# *"We helped a customer stop frequent outages and get safe motor protection . . . by recommending FUSETRON Fuses"*

OSCAR O'NEAL SR., PRES.
O'NEAL ELECTRIC CO., GULFPORT, MISS.

**Play Safe! install FUSETRON dual-element FUSES**

*Mr. O'Neal continues . . .*

"Sometime ago, the Gulfport Ice Co., called us in to do their electrical maintenance work. At the time, they were having a great deal of difficulty with motor starting currents causing ordinary fuses to blow. They were using 100, 200 and 400 amp. ordinary fuses to protect the motors.

"These frequent outages disrupted the company's normal operation and created a costly and annoying situation. Just to replace the 400 amp., 250 volt ordinary fuses was costing them about $40 a month.

"My first recommendation to them was to change to Fusetron dual-element fuses in the proper size for safe motor protection. They did.

"The installation of Fusetron fuses was the 'key' to the problem. In the past five years I do not recall one 400 amp. Fusetron fuse having blown — and outages on the 100 and 200 amp. circuits have been very infrequent."

**YOU TOO, CAN GUARD AGAINST UNNECESSARY OUTAGES OR MOTOR BURNOUTS THAT CAUSE MEN AND MACHINERY TO STAND IDLE SIMPLY BY INSTALLING FUSETRON DUAL-ELEMENT FUSES THROUGHOUT THE ENTIRE ELECTRICAL SYSTEM.**

*In addition to saving you money by protecting against needless outages and motor burnouts*

## FUSETRON Fuses offer High Interrupting Capacity and Life-Time Dependability Essential to Modern Protection.

**High Interrupting Capacity:** With electrical network capacities steadily increasing, — a *modern* protective device must be capable of interrupting the heavy fault currents now available and to be adequately safe to allow for anticipated growth in service demands.

FUSETRON fuses give you this protection. They have an exceptionally high interrupting rating of 100,000 amperes rms symmetrical.

**Life-Time Dependability:** The increase in available fault currents has emphasized the need for dependability in modern protective devices, otherwise, serious fire and personal injury can result should the device fail to operate when an emergency arises.

FUSETRON fuses provide safe and accurate protection through the years as their operation depends on a simple thermal law. Unlike mechanically operated devices, Fusetron fuses have no hinges, pivots, latches or contacts to stick or get out of order.

Once properly installed, Fusetron fuses require no maintenance, — no periodic inspection and accompanying down-time.

If you are considering a new installation or the modernization of an electrical system — you can be sure of modern, safe, maintenance-free protection in 10 or 20 years by installing Fusetron dual-element fuses now.

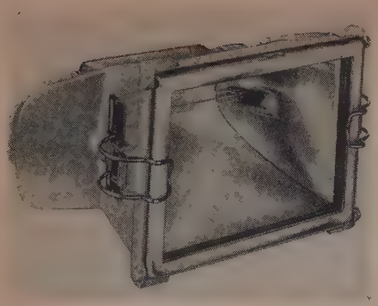
*For more information on FUSETRON dual-element fuses . . . Write for bulletin FIS.*

**BUSSMANN MFG. DIVISION**
McGraw-Edison Co.
St. Louis 7, Mo.

760

***throughout entire Electrical System!***

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
McGRAW EDISON



### Lighting Unit (12)

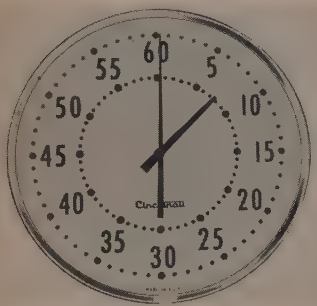
The new Intenso "Quartzlite 500" Quartzline lamp lighting unit, Model G-6000, is now available. Unit gives light control and high operating efficiency provided by the iodine cycle Quartzline 500-watt, 120-volt tubular incandescent lamp. The lamp also maintains its 21 lumens per watt output throughout the 2,000-hour lamp-life rating. For use in industrial, commercial and recreation facilities.

*Appleton Electric Co., 1701 Wellington Ave., Chicago 13, Ill.*

### Cabinets (13)

Telephone cabinets in two types and 19 sizes have been added to this line. The "PS" type surface cabinet is designed for exposed or surface work, while the "PF" type flush cabinet is suitable for concealed or flush installations. Both types are available in standard stock sizes from 12 in. high by 12 in. wide by 4 in. deep to 24 in. high by 24 in. wide by 6 in. deep. Cabinets can be provided with either single or double doors, as required.

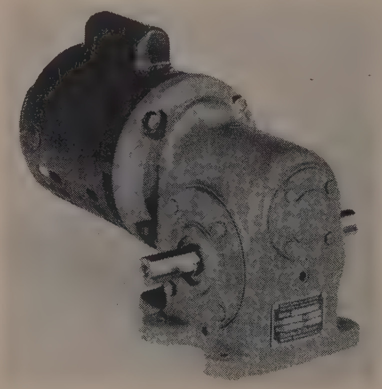
*Keystone Mfg. Co., 23328 Sherwood Rd., Warren, Mich.*



### Interval Timer (14)

A new interval timer for timing of specific activities in laboratories, hospitals or in schools and industry. Each timer, equipped with the usual hour and minute indicators plus second markers, can be set from a zero point, like a stop watch, to time an activity down to the second within a 60-minute time period. Then the timer can be reset for clocking the next operation or restarted to continue timing the original activity if there is an interruption. Electrically controlled, each timer is driven by a single synchronous motor. Timers may be flush or surface mounted on walls. Operating voltage is 115 volts ac. Power required is 3 watts when running, 9 watts when resetting. They are available with dial exposure diameters of 12 and 15 in.

*Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio.*



### Gearmotor (15)

A new versatile "C-Flange" gearmotor has been developed. Motor and reducer are separate, flange connected, so the unit is furnished either as a complete assembly, or reducer alone will be supplied for application to the customer's standard NEMA motors. When drive conditions change, either motor or reducer may be changed without scrapping the other element. Capacities range from 1/12 to 2 hp, reductions from 5:1 to 60:1. Literature is available.

*Morse Chain Co., Ithaca, N. Y.*

### Luminous Ceiling (16)

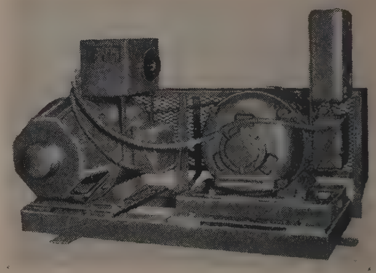
New illuminated ceiling, called "Capri," is primarily for bathroom application. A free floating luminous ceiling featuring "Paragrid-Tile" provides distribution of light over the ceiling area and makes possible its use in areas with low ceilings. The luminous tile spanning between specially designed satin texture, anodized finished aluminum channels make a rust and corrosion resistant unit. Literature is available.

*J. A. Wilson Lighting, Division of Wilson Research Corp., P. O. Box 5037, Erie, Pa.*

### Connectors (17)

A new line of electrical fittings and accessories to be known as "Bronco-Grip Connectors," including connectors for both copper and aluminum wires. Types initially offered are split bolt, vise grip, service entrance, various clamps, parallel connectors, aluminum compression sleeves, solderless terminal lugs, grounds clamps and straps. Catalog is available.

*Western Insulated Wire Company, Los Angeles 58, Calif.*



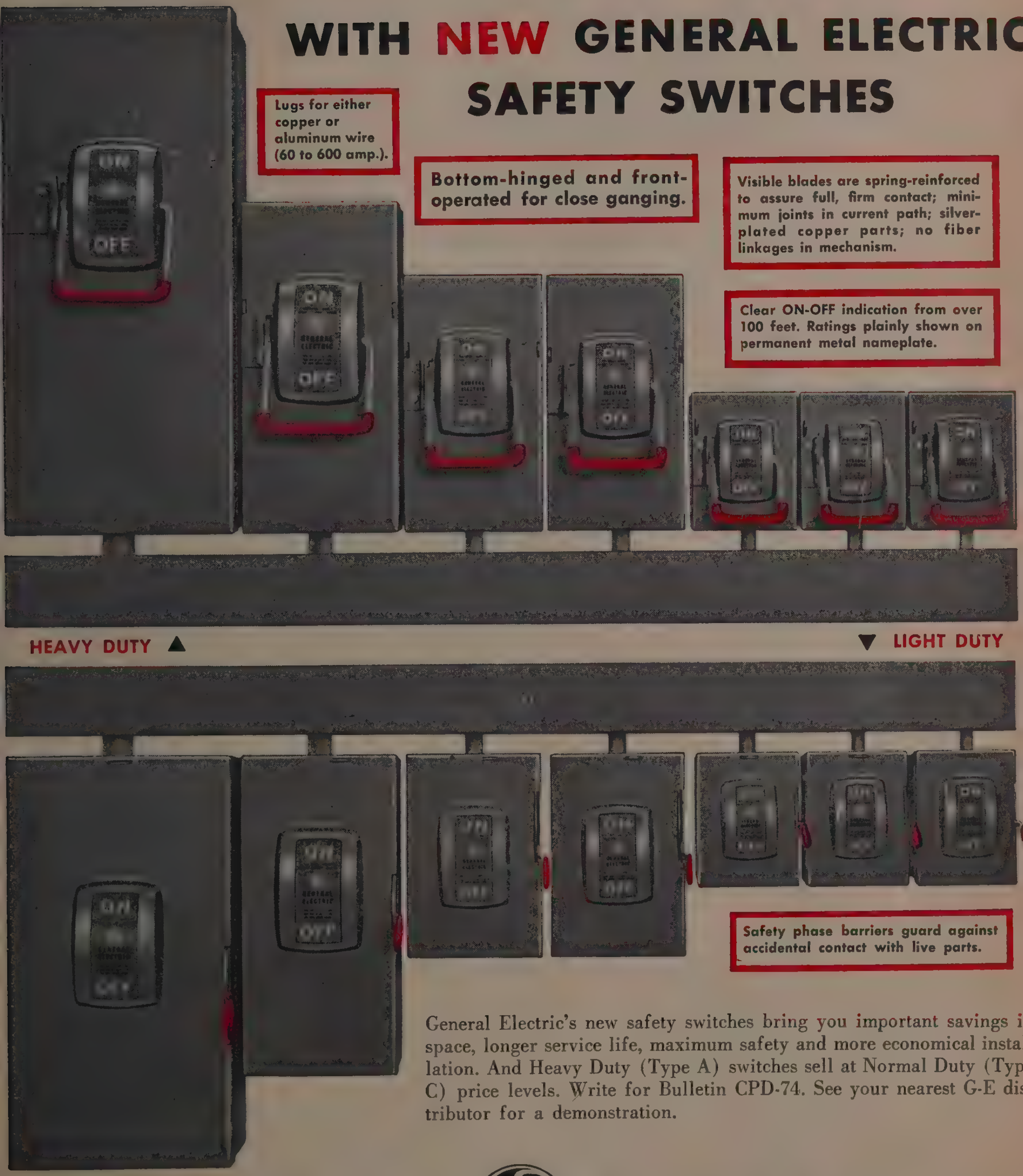
### Alternators (18)

A new line of high-frequency motor alternators has been designed for high-cycle current, and there are nine basic models ranging from 1 to 7.5 kva and producing 360 to 3300 cycles. Overall dimensions are about 50 by 27 by 26 in. Alternator assembly features a high-frequency alternator, a silicon rectifier unit with time-delay fuses for field excitation, and an R&M drivemotor. Revolving field construction is used in ratings of 1500 cycles and lower, while a brushless inductor type is supplied for ratings over 1500 to accommodate higher operating speeds. Sets are equipped with a pulley system matched to desired output frequency, but in applications where a number of frequency changes are anticipated, variable pitch pulleys or variable speed drives can be furnished.

*Industrial Motor Div., Robbins & Myers, Inc., Springfield, Ohio.*

# SAVE SPACE

## WITH NEW GENERAL ELECTRIC SAFETY SWITCHES



Lugs for either copper or aluminum wire (60 to 600 amp.).

Bottom-hinged and front-operated for close ganging.

Visible blades are spring-reinforced to assure full, firm contact; minimum joints in current path; silver-plated copper parts; no fiber linkages in mechanism.

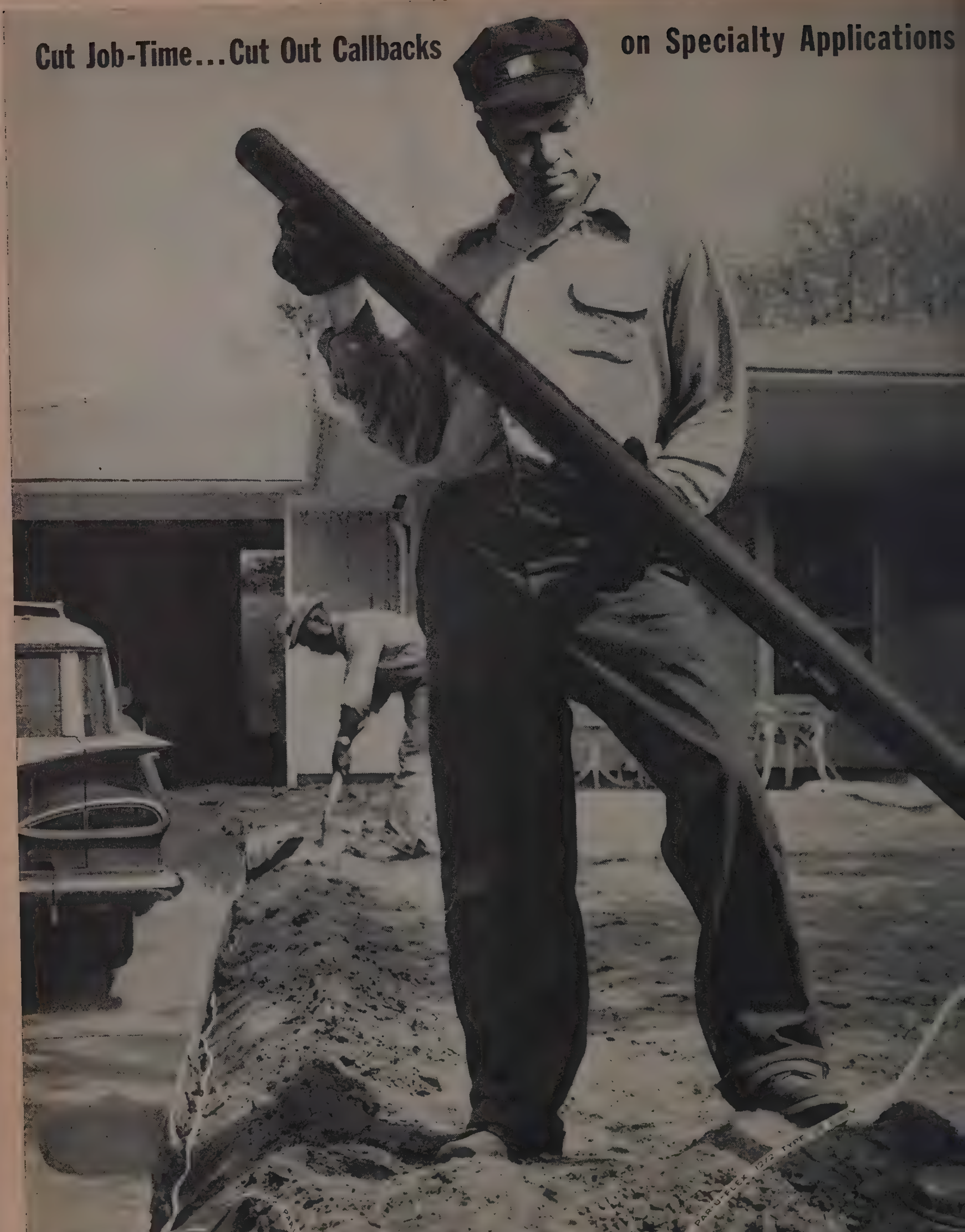
Clear ON-OFF indication from over 100 feet. Ratings plainly shown on permanent metal nameplate.

Safety phase barriers guard against accidental contact with live parts.

General Electric's new safety switches bring you important savings in space, longer service life, maximum safety and more economical installation. And Heavy Duty (Type A) switches sell at Normal Duty (Type C) price levels. Write for Bulletin CPD-74. See your nearest G-E distributor for a demonstration.

**GENERAL ELECTRIC**

Circuit Protective Devices Dept., Plainville, Conn.


Cut Job-Time...Cut Out Callbacks
on Specialty Applications
PARA-U-FLEX 12/2 TYPE UF 600 V
PARANITE PAR-U-FLEX 12/2 TYPE

ith Dependable **PROFIT PACER**

# PARANITE®

## BUILDING WIRES AND CABLE

Outdoor Living offers the qualified electrical contractor countless opportunities for profitable specialty installations. Yardlights, patio and pool wiring and drive illuminations are a few examples. Since ome-owners insist on out-of-sight installations, Paranite PAR-U-FLEX® Type UF is the ideal cable. This roduct, as with all Paranite Wires and Cable, represents the finest quality construction available! Paranite sets the pace with modern packaging, too! Color-coded labels assure instant identification, avoid errors. Yet Paranite costs no more than products offering less!

*Since 1890*

**PARANITE WIRE AND CABLE DIVISION**

***ESSEX WIRE CORPORATION***
***Marion, Indiana***

MANUFACTURING PLANTS
Marion, Indiana; Jonesboro, Indiana;
Tiffin, Ohio; Anaheim, California

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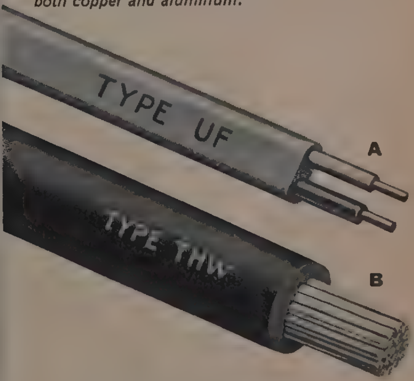
★ Birmingham, Ala., 2901 35th Ave., North
★ Chicago, Illinois, 411 South Peoria Street
★ Cleveland, Ohio, 1721 Superior Avenue
★ Dallas, Texas, 9132 Directors Row
★ Detroit, Michigan, 6233 Concord Ave.
Fort Wayne, Indiana, 1601 Wall Street
Hartford, Connecticut, 1731 Park Street
★ Kansas City, Missouri, 2000 Forest Avenue
★ Los Angeles, California, 6415 E. Fleet Street
Louisville, Kentucky, 2416 Frankfort Avenue
Memphis, Tennessee, 4880 Kaye Avenue
★ Minneapolis, Minnesota, 3230 East Hennepin Ave.
★ Newark, New Jersey, 457 Frelinghuysen Avenue
Omaha, Nebraska, 320 W.O.W. Building
Orlando, Florida, 3007½ Edgewater Drive
Phoenix, Arizona, 213 North First Avenue
Pittsburgh, Pa., 3530 Forbes Ave.
★ Portland, Oregon, 3322 N. W. 35th Avenue
Upper Darby (Philadelphia), Pa., 6816 Market St.
Rochester, New York, 15 Warrington Road
★ Saint Louis, Missouri, 5959 St. Louis Ave.
Seattle, Washington, 2208 White-Henry-Stuart Bldg.
★ South San Francisco, California, 274 Harbor Way

*Paranite wire and cable products are readily available from leading distributors across the nation in a full range of sizes and conductors, both copper and aluminum.*



**A.** PAR-U-FLEX Type UF-600 V nonmetallic cable is insulated and jacketed with Thermoplastic. Resistant to moisture, corrosion, fungus and abrasion. Provides protection against strong detergents, acids and alkalies. Single-, two- and three- conductor construction, with or without ground wire. Meets NEC requirements for underground feeder or branch circuit wiring; and for wiring in exposed locations for farm and industry.

**B.** PARASYN® Type THW Thermoplastic insulated 600 V building wire is UL listed for wet or dry applications. Small diameter, slick silicone finish, color availability and stripping ease assures reduced handling costs. Solid and stranded, 14 AWG through 500 MCM.

### Reflectors (19)

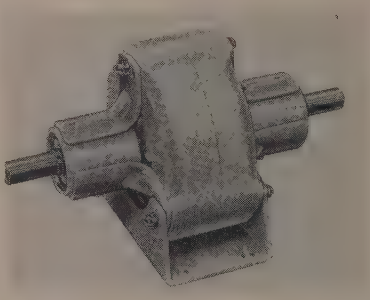
A new line of etched Alzak aluminum reflectors for high and medium mounting. They are available in 16- and 18-in. diameters. Units conform to RLM standard 40 and are available with socket type or exclusive Quad Easy-Tach construction for pendent or box type mounting. They have interchangeable hoods that are varied in length for positioning light source correctly in each size reflector. Hoods are finished gray porcelain enamel. White hoods are also available for use with gray ones for keying units when used in twin mounting in combination installations of mercury vapor and incandescent lamps. Glass covers are available for both 16- and 18-in. reflectors.

*Quadrangle Manufacturing Co., 32 S. Peoria St., Chicago 7, Ill.*

### Switch and Fuse Equipment (20)

Major redesign of GE rollout switch and fuse equipment has placed emphasis on ease of operation and safe, uncomplicated maintenance. New, simplified stored-energy mechanism can be quick-charged with a single stroke of operating handle. Quick-break tripping action results in less arc time. Switch will close and latch against a full momentary-current rating of 60,000 amps on 2.4 through 7.2 kv systems and on 50,000 amps for systems up to 13.8 kv. Current-carrying parts are isolated from charging mechanism. A positive interlock arrangement allows switch and fuse element to be rolled out of its enclosure for routine maintenance only when switch contacts are completely open. A Self-X insulated shutter automatically covers primary contacts to protect operator when switch and fuse unit is removed. Equipment cannot be replaced unless switch contacts are completely open, and protective shutter remains in place until unit is rolled back into enclosure. An optional lock-open, lock-closed feature is provided so that switch cannot be opened or closed unless key is available. Available now in ratings of 2.4 to 13.8 kv, equipment applications include light-duty indoor or outdoor switching and protection duty for feeder circuits, small power and lighting transformers, and for load-center unit substations.

*General Electric Co., Schenectady 5, N. Y.*



### Clutch (21)

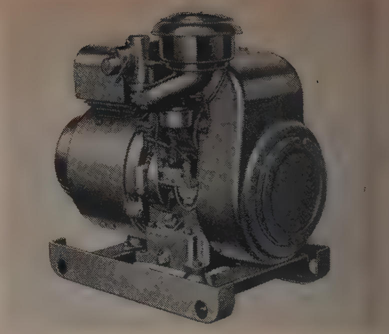
A lightweight version of its 10 lb-ft foot-mounted Magneclutch, dry magnetic particle clutch, has been introduced. The new clutch is a totally improved unit, offering faster response and longer life, plus the Magneclutch features of smooth operation, fast response, absence of wear on torque transmitting surfaces, torque at zero slip, transmitted with 100% efficiency, close control of acceleration and deceleration over the entire operating range. Bulletin 6106-5 is available.

*Vickers Incorporated, Electric Products Division,* 1815 *Locust St., St. Louis* 3, *Mo.*

### Conduit (22)

New hot-dipped galvanized rigid steel heavy wall conduit is produced in standard trade sizes ½ in. through 6 in. with zinc-protected threads. Plastic thread protectors are color coded for size identification. Galvanized couplings, standard and large radius elbows are available in full range of sizes. Conduit is listed by UL, and conforms to requirements of Federal Specifications WW-C-581-c; American Standards Specification C-80.1-1959; Bureau of Yards and Docks 9YG; American Society Testing Materials A120-57T.

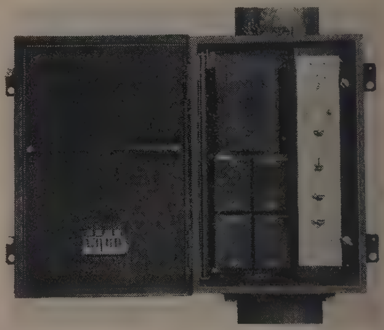
*Wheatland Electric Products Co.,* 7308 *Church Ave., Pittsburgh* 2, *Pa.*



### Electric Plant (23)

A new 2 kw electric plant powered by a Kohler K241 air-cooled engine. Available in models for automatic, remote, or manual starting and for gasoline or combination gas-gasoline operation, the plant is adaptable for many applications in industry, in construction field, for railroads, for fleet and trailer use. Single-phase generator supplies 60-cycle ac at 115 or 115-230 volts. Vibro mounts, skid type base, fuel pump, sediment bowl, fuel filter, oil-bath air cleaner, and muffler are standard equipment.

*Kohler Co., Kohler, Wis.*



### Control (24)

An improved 3-phase control for automatic transfer of a load from one distribution line to another is now available. Control, designated Type S, features easy selection of various operating sequences, enclosed relays, dead-front construction, and a hinged panel for access to internal wiring. Type S is intended for use with L-M Type NR or VR oil switches, Type R or W reclosers, circuit breakers, or other switches. Type S control is rated for operation from 60-cycle, 120-volt, ac sources. Time-delay, provided to insure coordination with backup protective devices, ranges from 2 to 57 or 10 to 285 seconds.

*Line Material Industries, McGraw-Edison Company, Milwaukee* 1, *Wis.*

# FLUORESCENT LAMP BALLASTS

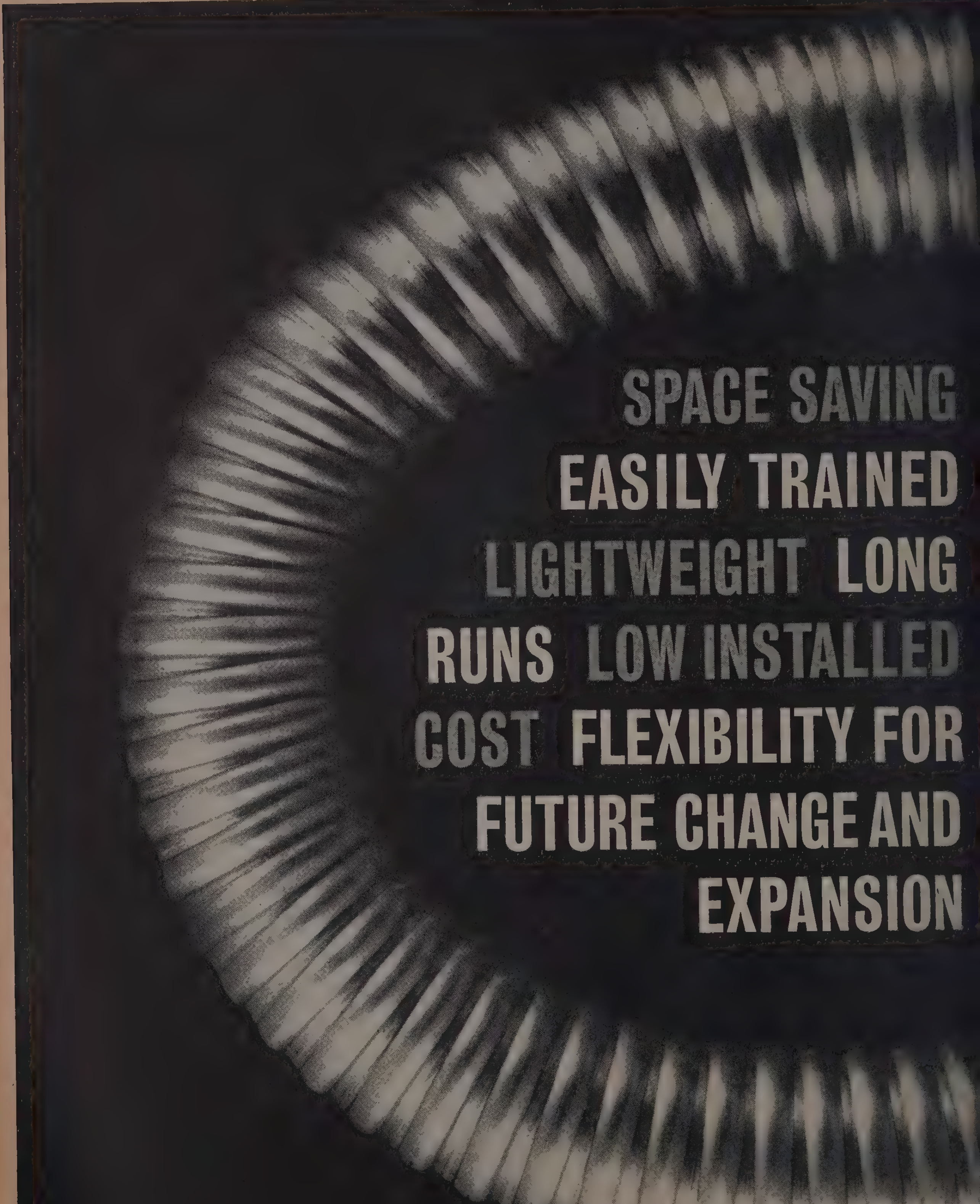
Yes, take a good look . . . you'll see the results of more than three years of research by ADVANCE engineers developing new grades of steel, testing larger diameter wire, incorporating special insulating materials and compounds. Another look at test results made in a standard 40° C. CBM and U/L heat box will show that Kool Koil Fluorescent Lamp Ballasts operate 16.5° C. to 19.5° C. cooler than any other ballasts tested; give up to 15% more light output for higher illumination levels and increase ballast life 3½ to 4 times.

No matter how you look at ADVANCE Kool Koil Fluorescent Lamp Ballasts, whether you are a distributor, contractor, specifier, manufacturer or user, you'll see these are ballasts designed to serve you better. Remember too, all ADVANCE Fluorescent Lamp Ballasts are available individually packaged for immediate replacement for any make ballast through more than 1000 ADVANCE Service-Stocking Distributors in the United States and Canada.

*"The Heart of the Lighting Industry"*®

**ADVANCE®**
**TRANSFORMER CO.**
2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

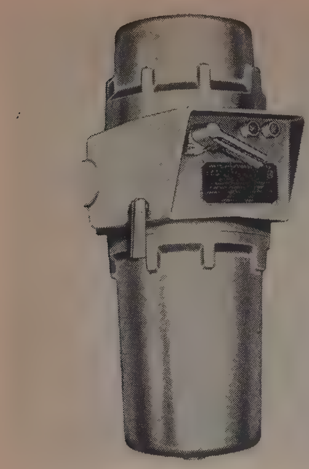
**Manufactured in Canada by: ADVANCE TRANSFORMER CO. Ltd., 5780 Pare St., Montreal, Quebec, Canada**


SPACE SAVING
EASILY TRAINED
LIGHTWEIGHT LONG
RUNS LOW INSTALLED
COST FLEXIBILITY FOR
FUTURE CHANGE AND
EXPANSION

# GENERAL CABLE

# NTERLOCKED ARMORED CABLE

For full protection under all conditions install General Cable Interlocked Armor...the cable for power, control, communication and lighting systems. This compact, versatile cable is available n a wide range of constructions, insulations, armors and voltage ratings. Colored polyvinyl chloride jacket over the armor can be furnished where required. "How to Obtain the Greatest Advantage Per $ Spent" a comprehensive folder detailing General Cable's complete line of Interlocked Armored Cables is available upon request. **General Cable Corporation**, 730 Third Avenue, New York 17, New York. Offices and Distributing Centers Coast-to-Coast.



**Motor Starters** **(25)**

A new line of motor starters, circuit breakers and combinations of both. Designated as Model 60, Series ECS Pylets, all types are explosion-proof, dust-tight and weather-resistant for indoor and outdoor use. Features include cast aluminum threaded enclosures with stainless steel exterior hardware for positive weather protection and corrosion resistance. Enclosure consists of central body externally threaded at top to accept internally threaded overlapping dome. Body is oppositely threaded at bottom. Threads are of square or buttress Acme type. Both domes have safety interlock. Operating handle is arranged to take three padlocks in either the "On" or "Off" position without interference with trip-free action of circuit breaker. Other features include adjustable starter and breaker mounting frames. Literature is available.

*Pyle-National Company,* 1334 *N. Kostner Ave., Chicago* 51, *Ill.*

**Fittings** **(26)**

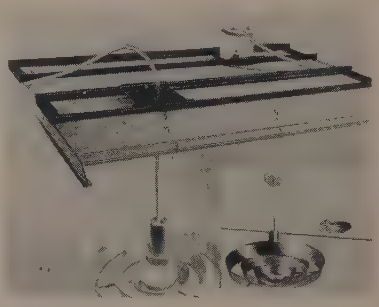
Designed to simplify installation and reduce inventories, four new fittings, which obsolete ten fittings previously required, have been developed. New boxes are all intended for use with company's series 200, 500 and 700 surface metal raceways. Fittings, designed series 57200, consist of a single pole switch and box, utility box, duplex receptacle and box, and duplex grounding receptacle and box. Grounding receptacle previously was not available in the 200 series. Cover has twistouts on each end and each side for all three series of raceways. Position of twistouts on ends permits running raceway close to interior trim. Base has knockout for ½ in. connector and tongues can be broken off when not used. Dimensions are: length, 4⅛ in.; width, 2 in.; and depth 1⅜ in. Switch is rated at 10 amps, 125 volts or 5 amps, 250 volts. Both duplex receptacle fittings are rated 15 amps, 125 volts.

*Wiremold Company, Hartford, Conn.*

**Beam Clamp** **(27)**

A new, heavy-duty beam clamp, named Senior Beam Clamp, is designed to support heavy piping, conduits, hanger irons, etc. and securing them onto standard-sized ceiling channels, web joists, "I" beams or other building framework requiring heavy-duty, flush-mounted fastening. It keeps conduit runs straight and even, because it mounts flush against channel. Clamp features a case-hardened, hexagon-headed, slotted, cup-pointed screw.

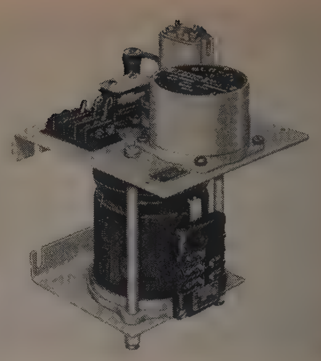
*Paine Company,* 38 *Westgate Road, Addison, Ill.*



**Mounting Frame** **(28)**

New Fenco mounting frame is specifically designed for suspended ceiling, for recessed or surface mounted lighting fixtures and/or sound control equipment. Mounting frame is suitable with any type suspended ceiling and all rail spacing. It offers complete interior lighting design flexibility since frame can be located in any desired position and used with any desired fixture.

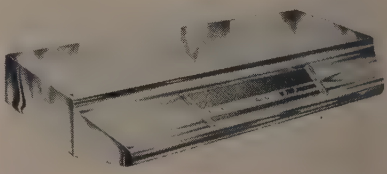
*Belmar Lighting Co., Garnerville, N. Y.*



**Transformers** **(29)**

More flexible design of systems having loads up to 7.5 kva is now possible with the introduction of motor-driven Powerstat variable transformers of the 116, 117, 216, 217, 126 and 226 Series. Smaller assemblies can now be used in remotely controlled applications where the motor-driven variable transformer is installed in any out-of-the-way space and the pushbutton or raise-lower switch placed wherever desired. Units use new type SS50 Slo-Syn synchronous motor for driving. Planetary gear reduction assemblies provide speeds of 5, 15, 30 or 60 seconds for full range travel from zero to maximum output voltage. Literature is available.

*Superior Electric Co., Bristol, Conn.*



**Ductless Hood** **(30)**

New electronic hood operates on principle of electrostatic ionization. Smoky, grease-laden air is drawn into hood by blower action. Individual microscopic particles pick up an electrical charge. They are then fed to an electrically-charged collector plate, to which they are attracted and adhere. After particle removal, the pure air is blown back into kitchen. Hood is affixed to wall above range, operates off standard 110-volt current. Choice of three permanent finishes —antique copper, stainless tone enamel and solid stainless steel—rust resistant. Hoods are available in 30-, 36- and 42-in. models.

*Progress Manufacturing Co., Philadelphia* 34, *Pa.*

**RUGGED YEARS AHEAD . . .**

*that's why the job demands SLIPKNOT*

Whether you're splicing transmission lines or residential outlets, every splice you make must be final, safe and *permanent*. You can't afford any tape but the *best* . . . and the best costs no more. SLIPKNOT PLASTIC ELECTRICAL TAPE is the choice of the country's most experienced electricians, because it *handles easily, conforms readily*, and *snugs* and *stays down*.

With adhesive permanently anchored to vinyl base, with controlled tension for proper stretch without dangerous thinning — with absolute conformity, roll after perfect roll — no wonder SLIPKNOT is the specified tape. The patented cutter, packed free with every 66-foot roll, speeds the job and saves you money.

Find out why SLIPKNOT is found in all the best splices. Try a roll today.

TAPES BY
SOLD ONLY
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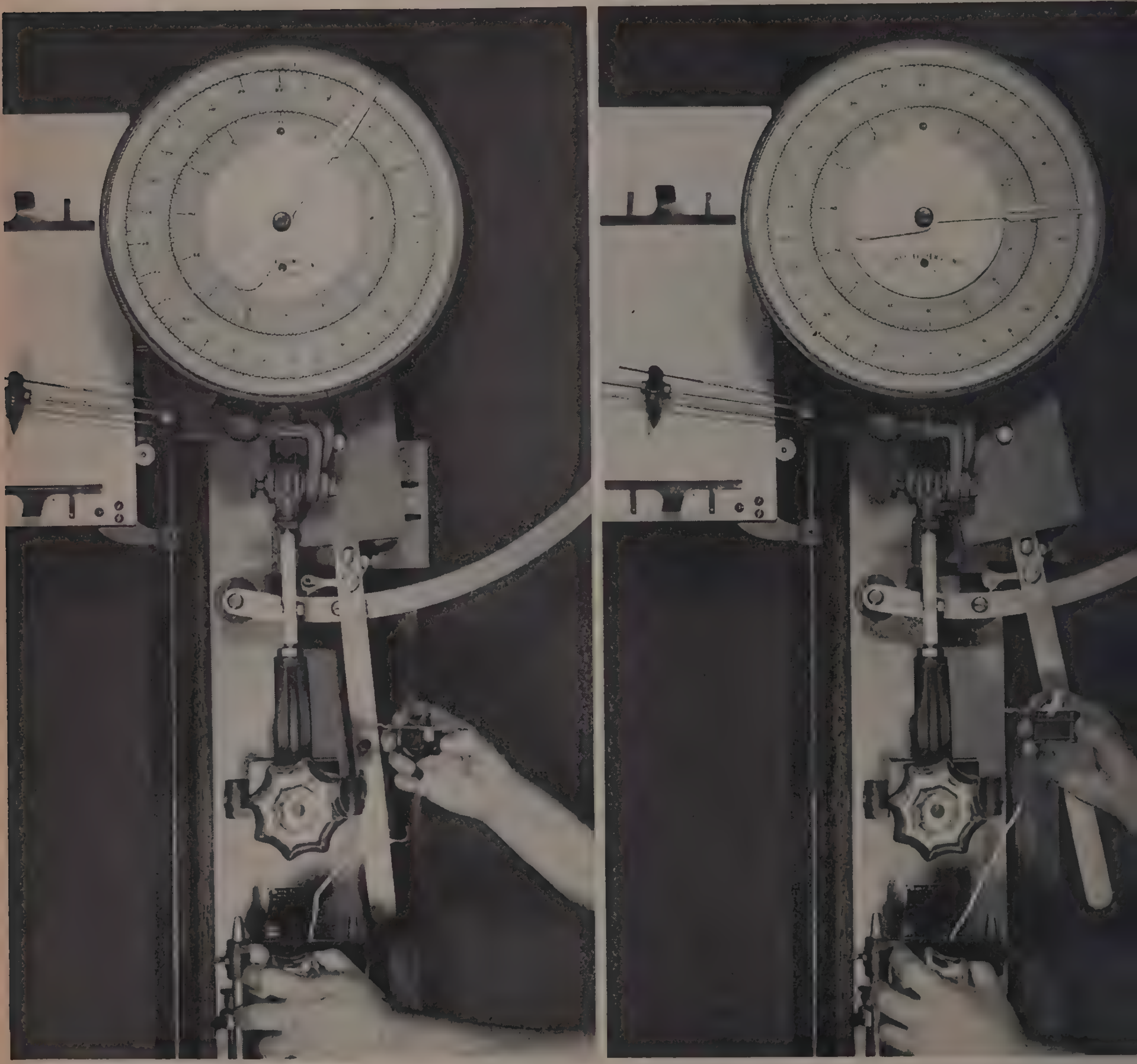
**PLYMOUTH RUBBER COMPANY, INC.**

QUALITY SINCE 1896 *Makers of* SLIPKNOT FRICTION TAPE *— most widely used in the world* CANTON, MASSACHUSETTS

# Laboratory tests prove General make better connections



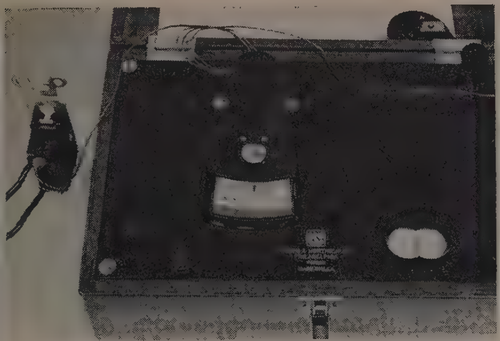
**1. Better mechanical connections** — This testing machine shows that a wire can be pulled out of an average binding screw connection (in left photo) by a force of about 30 pounds. Yet a G-E Pressure-Lock* terminal (in right photo) is good for 80 pounds! You can see the tight Pressure-Lock grip is more than adequate for any wiring job.

General Electric recommends its 135 switches, outlets and lampholders with Pressure-Lock terminals for the most modern, tight wire connections. Of course, it offers a complete line of wiring devices with binding-screw and clamp-type terminals, too.

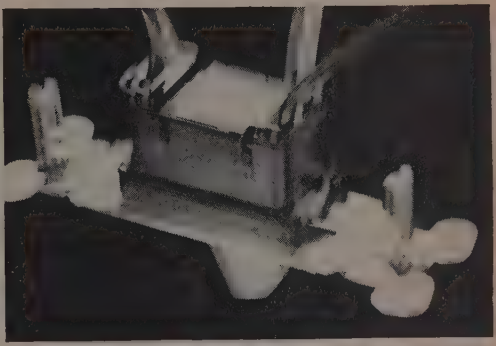
Ask your General Electric distributor to show you the many new ideas — the extra-quality features and the wide choice of wiring devices that you get in the complete G-E line. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

*Registered trade-mark of General Electric Company

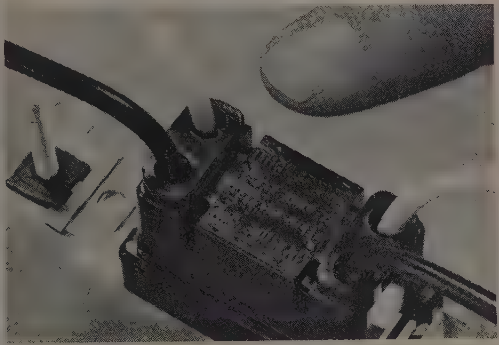
# Electric Pressure-Lock Terminals than binding screws!



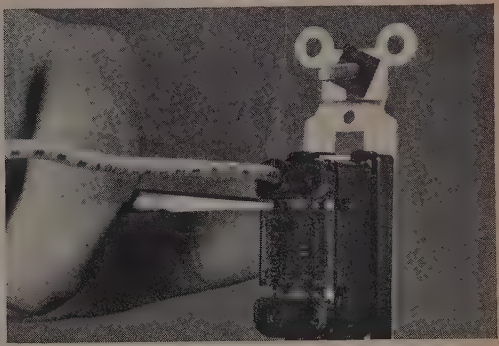
**2. Better electrical connections** — The temperature rise in a Pressure-Lock connection carrying 15 amperes is only 8°C — way below the U. L. allowed limit of 30°C! Humidity and salt do not affect this fine connection.



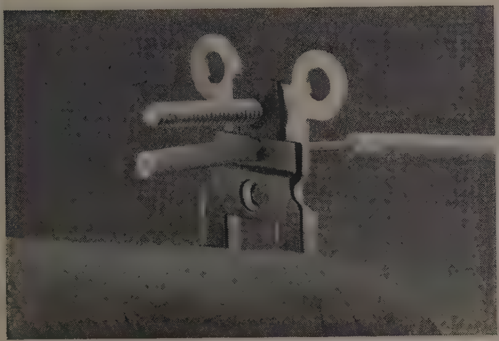
**3. Longer-lasting connections** — Pressure-Lock connections won't loosen under temperature changes or vibration the way screws do. And of course there is never any trouble with stripped threads, either.



**4. Extra safety** — Notice that back-wired Pressure-Lock terminals are totally enclosed, to protect against grounds and shorts. And, they don't bend or loosen when you press the device back into a box.



**5. Easy release when desired** — New, wide release slots permit convenient release of wires by pressing with regular-sized screwdriver. They also make handy contact points for ring-out testing.



**6. Built-in wire stripper** — Yours on several of the most-used G-E Pressure-Lock devices, at no extra cost. You just push a wire into a hole in the strap and pull out. A little steel blade strips it clean.

**7. Quality design** — A strong, steel locking spring that carries no current — a long, smooth contact channel — these are the reasons behind Pressure-Lock's performance. You get these quality features in no other terminal design.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

### Explosion-Proof Lamp (31)

Explosion-proof and weather-resistant Type EVH106 hand lamp is for use in hazardous locations. Weighing 4½ lbs, it is smaller in size, with all parts designed to withstand rough usage. Terminal housing encloses three pressure connector terminals, including grounding terminal. Molded-in conductors between lamp receptacle and pressure connectors ensure trouble-free internal fixture wiring. For relamping, guard, globe and holder assembly are removed as one unit and a new lamp installed. A swivel type hook holds lamp in position for use in tight spots, leaving both hands free to work.

*Crouse-Hinds Company, Syracuse* 1, *N. Y.*

### Circuit Breaker (32)

A new molded-case circuit breaker for short-circuit protection of motor circuits, providing a 40% saving in panel space, is available in continuous current ratings up to 100 amps with an interrupting rating of 15,000 amps at 600 volts ac. It provides in the small EH frame, the same protection previously available only on the larger F-frame breaker. Breakers feature selective short-circuit protection for electric motors through an adjustable magnetic trip which can be set just above the start-up inrush current to prevent unnecessary tripping. This adjustment provides five settings for instantaneous magnetic trip from front of breaker.

*I-T-E Circuit Breaker Company, Philadelphia, Pa.*

### Drives (33)

Electronic Select-A-Spede drives range in sizes from ¾ hp to 4 hp, and feature a dc motor powered from a wall-mounted electronic control panel, which is controlled by an operator's control station. Adjustable voltage is applied to motor armature from electronic control panel which converts the ac line voltage to a regulated rectified dc source. Drive provides accurate speed regulation to within 3% from no load to full load over an adjustable 8:1 speed range. Control switches are included to compensate for line voltage variations up to plus or minus 10%. Control also includes zero speed start and time rate acceleration features which prevent excessive motor or tube currents and provides smooth starts and gradual acceleration. Bulletin No. 101 is available.

*Louis Allis Co.,* 427 *E. Stewart St., Milwaukee* 1, *Wis.*

### Box (34)

A new general-purpose weatherproof box design for mounting gang-operated oil-filled cutouts. Type BZ box is drip proof, splash proof, and moisture resistant, conforming to NEMA standards for indoor and outdoor installations under non-submersible conditions. Four knockouts, one at each end, two at bottom of box, provide flexibility in choosing points of cable entry at the installation site. Bottom ground lugs permit side-by-side mounting, flush wall mounting, or other means of support. Type BZ cutout boxes are constructed of No. 10 gauge steel. New box design is made in three sizes to accommodate G&W FC31, FC42, or FC61 cutouts rated 2.5, 5 and 8 kv.

*G & W Electric Specialty Co.,* 3500 *W.* 127*th St., Blue Island, Ill.*

### Conduit (35)

New line of rigid aluminum conduit, elbows and couplings in a complete range of standard trade sizes up to 6 in. is available. Conduit is approved by UL. Exclusive features of the rigid conduit 90° elbows are the maintenance of cross-sectional shape in the bend area and full interchangeability with steel elbows. Rigid conduit is shipped with color-coded thread protectors to shield threads and facilitate storage and handling. A special electrical thread lubricant for aluminum conduit also has been developed.

*Harvey Aluminum,* 19200 *S. Western Ave., Torrance, Calif.*

### Ballast (36)

A "C" sound rating in aluminum fixtures and a "D" rating in steel fixtures has been achieved with a new single case two lamp 1500 ma rapid start ballast, Catalog No. 930-X. It is for use with any two VHO, PG, SHO, T10 or T10J rapid start lamps in 72- and 96-in. lengths on 120-volt, 60-cycle lines. It is suitable for school lighting systems as well as for non-weatherproof use in outdoor fixtures and signs. Literature is available.

*Universal Manufacturing Corp.,* 29-51 *East* 6*th St., Paterson* 4, *N. J.*

### Anchor (37)

A complete line of 14 self-drilling anchors that includes types for hand installation, as well as impact hammer, is being marketed under tradename "Hi." Anchor is a combination drill and fastener that incorporates new features. Each anchor has eight cutting teeth of special design and shape. Three types are offered: "flush" type, for installation with a hand hammer and holder, in six sizes, ¼ in. through ¾ in.; "snap-off" type, for installation with electric or pneumatic hammers, in seven sizes, ¼ in. through ⅞ in.; "tie-wire" type for hanging fluorescent lighting fixtures, suspended ceilings, plaster forms, securing wire and guy-wires, in one size only.

*Holub Industries, Inc., Sycamore, Ill.*

### Bulb (38)

An electric bulb that brings the intensity and color of natural sunlight into an industrial plant or commercial establishment has been developed. The bulb is a Fluomeric, a development that combines features of incandescent, fluorescent and mercury vapor lighting. In 1750 watts, it delivers almost 60,000 lumens. Operating without ballasts, it screws into an ordinary incandescent mogul socket. It is life-rated for 10,000 to 12,000 user-hours. The new 1750-watt size is manufactured in 208 and 230 volts with a BT-57 bulb shape and mogul strap base. It is available in clear for narrow beam distribution and in Power-Lite.

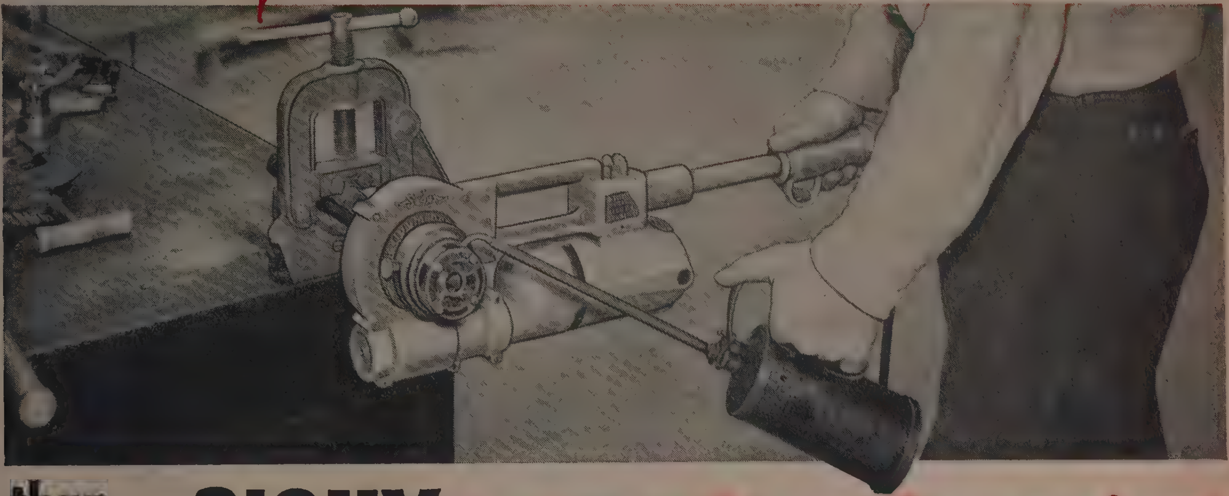
*Duro-Test Corporation, North Bergen, N. J.*

### Connectors (39)

A hammer is the only tool needed to make a connection with "Red-E" lugs and receptacles. They are installed by inserting the stripped cable and then driving down a self-contained impact punch with an ordinary hammer. Connectors are available in a full range of sizes, from No. 6 through 1 and 1/0 through 4/0. The flat base impact nest retains the roundness of the bottom portion of the barrel as top portion is indented by driving down a self-contained malleable impact punch. All "Red-E" connectors are the heavy-duty type.

*Bernard Welding Equipment Co.,* 10232 *South Ave. N., Chicago* 17, *Ill.*

# "Nothing Ever Saved More Time"....



# than the new SIOUX Power Pipe Threader!

With the Sioux Power Pipe Threader you can thread ¼″ to 1″ pipe in 20 seconds; 1″ and 2″ pipe in one minute, 24 seconds! When labor costs 6½ cents per man per minute, a power tool like this for which there is a continuing need doesn't take long to pay for itself. The Sioux Power Pipe Threader is said to be saving more time and money than any other major portable power tool!

Sioux No. 1508 Pipe Threader in use with No. 1511 Speed Reducer.

Thread Pipe on the Job, in a hurry. Once the unit is in place it only takes one hand.

Driving Geared Die Stock with Sioux No. 1508 Pipe Threader and No. 38002 Adaptor.

Wire is Pulled Through Conduit with Sioux No. 1508 Pipe Threader and No. 1509 Portable Winch.

**Your SIOUX Power Pipe Threader will also thread bolts; drill; auger; and open and shut valves. (It's a versatile, portable power package!)**

SIOUX

*Look for Sioux in the yellow pages under "Tools, Electric" or write to*

**ALBERTSON & CO., INC.**

SIOUX CITY, IOWA, U.S.A.

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • ELECTRIC IMPACT WRENCHES • DRILLS • SCREWDRIVERS • GRINDERS • SANDERS • POLISHERS • FLEXIBLE SHAFTS • PORTABLE SAWS • VALVE GRINDING MACHINES • ABRASIVE DISCS

# More power for expansion supplied with USS Tiger Brand Armorlokt Cable over unique suspension bridge

This suspension bridge was built especially to carry high-voltage electrical cables from the power plant to mill at the Ohio Works of United States Steel in Youngstown. The old underground system has become inadequate and to replace it with a new underground system would have been more costly and would have disrupted mill operations.

The largest of the several cables has 500,000 C/M conductors and is 3¾ inches in overall diameter. All are insulated with Amerzone B (Butyl) rubber and protected with interlocked armor.

**Armorlokt cable was used for utmost reliability.** Failures of power distribution are costly, and represent production losses. This Armorlokt construction offered maximum mechanical protection and electrical reliability with the added "Plus" of complete flexibility of the finished distribution system.

**Advantages of open construction.** Compared to an underground conduit system, the original cost was considerably less, it provided easy access to the cables for future changes and maintenance and the space on the bridge was large enough to carry double the number of cables for future expansion.

The system was planned by the Electrical Engineering Department of the Ohio Works, United States Steel, of which Mr. M. J. Burger is General Supervisor.

For complete information on USS Tiger Brand Armorlokt Cable, write American Steel & Wire, Dept. 0259, 614 Superior Ave., N.W., Cleveland 13, Ohio.

*USS, Tiger Brand, and Armorlokt are registered trademarks*

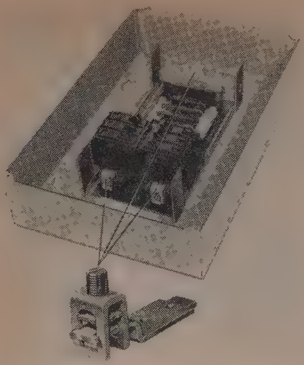
**A standard cable for every special job** • Asbestos Wire and Cable • Mold-Cured Portable Cord • Shovel & Dredge Cable • Paper & Lead Cable • Varnished Cambric Cable • Interlocked Armored Cable • Special Purpose Wire & Cable • Aerial, Underground and Submarine Cable

◀ **Suspension bridge** carrying six USS Tiger Brand Armorlokt Cables out in the open for easy access.

**USS Tiger Brand Armorlokt Cables** offer maximum mechanical protection and electrical reliability. They can be installed in half the time required for other systems, and can be easily pulled around turns.

**American Steel & Wire**
**Division of**
**United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad



### Load Centers (40)

A complete line of 100-amp QO circuit breaker and FSP fusible load centers with aluminum lugs is now available. These standard devices, approved for service entrance use, now permit use of either aluminum or copper conductors. Lugs are suitable for maximum size 0 wire, either copper or aluminum, and are also approved for double conductor applications. They are available as 100- or 125-amp main lug only and split bus devices in 6-, 8-, 12-, 16- and 20-circuit sizes. The 12-, 16- and 20-circuit main breaker devices are also available for use with aluminum cable. Type FSP fusible load centers cover the complete 100- to 200-amp range with series and parallel devices.

*Square D Company*, 1601 *Mercer Road, Lexington, Ky.*

### Motors (41)

A new controlled acceleration accessory unit for 1 to 75 hp Varidrive variable speed motors has been developed. To accomplish low initial torque, a reduced torque control unit is used. To suit varying load conditions and machine applications, starting torque is infinitely adjustable up to normal rated torque of motor. After setting control unit for desired starting torque, a compensator unit maintains this same approximate torque from starting to full operating speed. When operating speed is attained, control unit is automatically removed from circuit and the Varidrive operates normally. The controlled acceleration unit is designed to operate on standard 220/440-volt, 60-cycle power supply, and is constructed of long-life nonelectronic components. Bulletin F-1797 is available.

*U.S. Electrical Motors Inc., Box* 2058 *Terminal Annex, Los Angeles* 54, *Calif.*

### Floodlights (42)

New utility floodlights feature high-output anodized aluminum reflectors designed for light control with minimum glare. They are available open or fully enclosed with a heat-resisting cover lens and resilient neoprene-rubber gasket. Fully-adjustable reflector floods accommodate 75- to 300-watt general service lamps and are complete with a heavy-duty plate for surface, wall or box mounting. Bulletin C-1 is available.

*Stonco Electric Products Company*, 333 *Monroe Ave., Kenilworth, N. J.*

### Speed Drives (43)

Magnetic drives, in ratings from 75 hp to 4000 hp have been added to this adjustable speed drive line. Drives feature simplified design and provide versatile adjustable speed performance over an automatically regulated 20:1 range. Drive is based on a liquid-cooled magnetic-coupling design that features stationary field construction, bearings that can be relubricated without disassembly, and a unique cooling system. Cooling system design permits a planned flow of air through the drive at all times. Magnetic drives operate from ac power and are offered as a complete drive package including drive unit with water controls, controller enclosure and operator's station. Bulletin No. 3650 is available.

*Louis Allis Co.*, 427 *E. Stewart St., Milwaukee* 1, *Wis.*

### Drill (44)

This new core drill is designed to drill through masonry, stone, refractories, concrete and similar materials. An induction type motor with direct drive to the spindle is used. Full directional drilling, in which drill head can be rotated 360° on a 3-in. tubular steel column, permits drilling at any angle with base of drill remaining securely on any horizontal surface. Features include a load indicator, built-in motor overload protection by means of a magnetic type motor overload protector, and ease in raising or lowering drill head. Drills are available in three models. D-30, a 3-hp drill for holes up to 14 in.; D-20, a 2 hp drill for holes up to 6½ in., and DH-20, a hand-held drill for holes from ½ to 2 in.

*Clipper Manufacturing Co.*, 2800 *Warwick, Kansas City* 8, *Mo.*

### Floodlights (45)

Type RCDE-6 explosion-proof floodlight is available in a number of mountings, making it suitable for many indoor and outdoor applications in hazardous locations, Class I, Groups C and D. Available with a carrying handle and wheel base, or with carrying handle and telescoping tripod, the portable model is convenient to use for many maintenance and repair operations. To install floodlight permanently, it is provided with flat base and explosion-proof junction box. Cover of box supports floodlight and can be rotated for horizontal aiming. In this model, Type RCDE-6 can also be provided with a 2-in. threaded hub on bottom of junction box, for mounting on vertical conduit. Housing is cast corrosion-resisting aluminum alloy; door is cast aluminum threaded into housing. Lens is plain tempered glass held by a clamping ring. A terminal block is provided in junction box of all four types.

*Crouse-Hinds Company, Syracuse* 1, *N. Y.*

### Oil Switch (46)

A new single-phase oil switch, designated Type J, enables manual sectionalizing and load breaking on heavily loaded distribution lines. Switch can safely carry and interrupt its full rated current of 400 amps at voltages ranging from 2.4 to 14.4 kv. It has a momentary current rating of 13,500 asymmetric amps. It can be employed for manual sectionalizing, as a load-break device on lines or in substations, or for tie-line switching.

*Line Material Industries, McGraw-Edison Company, Milwaukee* 1, *Wis.*

### Fans (47)

A new line of belted axial flow fans to simplify changes in ventilation systems. A new bearing assembly suitable for loads to 50 hp is furnished with each fan, regardless of initial hp ordered. Universal motor mounting plate is pre-drilled for all motor frame sizes the fan can accommodate, so that capacity may be readily altered. Both standard and high pressure propellers are available, depending on system requirements, all with aluminum magnesium alloy cast airfoil section blades. Fans range from 30 to 60 in.

*Propellair Div., Robbins & Myers, Inc., Springfield, Ohio*

CRESCENT

INTERLOCKED ARMOR POWER CABLE

GIVES YOU *SPEED* and *ECONOMY* OF INSTALLATION

Crescent Interlocked Armor Cable with ALUMINUM or GALVANIZED STEEL ARMOR provides a flexible metal-enclosed method of wiring for power. Speed and economy of installation are the principal advantages of these cables since they can be placed on easily hung racks or attached to building surfaces. Maximum current carrying capacity is secured by the use of the varnished cambric insulation. For outdoor or damp location installation, it is furnished with SYNTHOL IMPERVIOUS SHEATH between the insulated conductors and armor, as illustrated above.

The Varnished Cambric insulated conductors are thoroughly protected by the Impervious Sheath of tough thermoplastic which is highly resistant to moisture, alkalies, acids and oils. This cable shows attractive savings when strung from messenger cables or in troughs outdoors or between buildings.

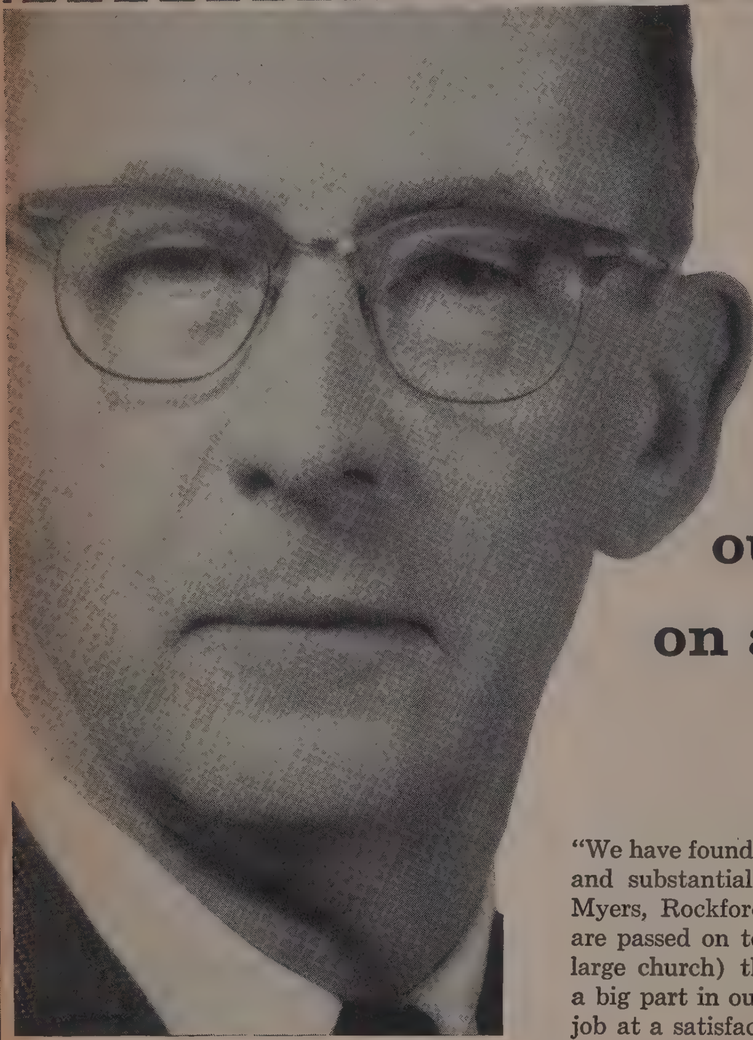
Crescent Interlocked Armor Cable also available with butyl rubber insulation.

**CRESCENT INSULATED WIRE & CABLE CO., INC.**

TRENTON, NEW JERSEY

# JOB-PROFIT TOOLING IDEAS

## FROM GREENLEE



## "Greenlee tools helped us streamline our operations and outbid competition on a tough contract"

says **Mr. Art Myers,** owner

**MYERS ELECTRIC**

"We have found that Greenlee tools mechanize much of our work and substantially reduce labor and material costs," says Art Myers, Rockford, Illinois, contractor. "The savings we realize are passed on to our customers. On this job (an addition to a large church) the increased efficiency of Greenlee tools played a big part in our getting the contract and being able to do the job at a satisfactory profit."

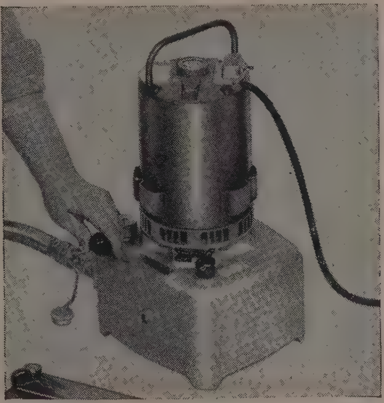
Art Myers went on to explain that the contract for the church addition posed many installation problems which could have run costs well over the bid figure. For example, 800-amp service had to be brought underground from a pole transformer located across a busy one-way street. Laying the conduit by old-fashioned methods meant trenching, laying the conduit, then filling and repaving.

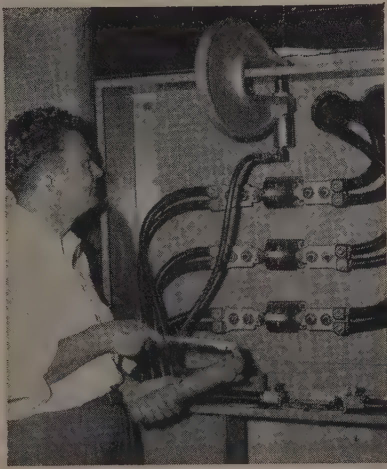
Myers solved this problem economically with a Greenlee No. 790 pipe pusher (right). The only digging necessary was a narrow trench for the pusher and a shallow ditch at the base of the utility pole. Pusher setup time was less than one hour . . . actual pushing time less than three hours for the complete job. Pushing the conduit underground, Myers reduced installation time 75% . . . and saved $500 by eliminating street repair costs.

Other time and cost savings made possible by Greenlee tools are outlined on facing page.

**Idea for making accurate conduit bends on the job** — Art Myers reports that his men make conduit bends and offsets more quickly and uniformly since a Greenlee No. 884 hydraulic conduit bender and a Greenlee No. 798 power pump were added to equipment inventory. Myers drives the No. 884 with a Greenlee No. 798 power pump. With this combination one man can bend 4″ conduit 90 degrees in 4 minutes . . . with one setup, one shot. Also, bending offsets on the job rather than buying manufactured bends and fittings has reduced material costs and cut installation time. Offsets made on the Greenlee bender reduced the number of fittings and connections . . . simplified cable pulling. Greenlee lightweight hydraulic benders are available for ½″ - 4″ steel or aluminum conduit. Attachments available for bending E.M.T., bus bars, and tubing. All models are completely portable . . . one man can transport benders from job to job.

**Idea for boosting operating speed on pipe pushers and benders** — Myers has discovered — along with many contractors throughout the country — that converting from hand operations to Greenlee power pumps provides an additional time saving on nearly every job. To power the pipe pusher, Art Myers selected a Greenlee No. 797 hydraulic power pump to push pipe underground at 2 ft per minute. A Greenlee No. 798 high-pressure, two-speed hydraulic power pump was purchased to increase operating speed on their No. 884 bender and No. 1732 one-shot knockout punch driver. Greenlee power pumps range in size from compact units like the No. 798 to the No. 797 that delivers up to 106 cu. in. per minute at 10,000 psi.





**Idea for making conduit openings . . . in seconds** — Greenlee one-shot knockout punch drivers prove real time- and money-savers when it comes to preparing distribution boxes for conduit. On the church addition, both the Greenlee No. 1731 (shown) and 1732 one-shot drivers were used. Fast, lightweight, and powerful, these compact drivers are set up and operated by one man. Punches cut through 10-gauge metal with a few strokes of the hydraulic pump . . . a power pump provides even faster operation. Two sizes: No. 1732 for punching ½″ - 4″ conduit holes; No. 1731 for ½″, ¾″, 1″ conduit openings. Greenlee knockout punches are available for conduit from ½″ - 5″ . . . with wrench, ratchet, or hydraulic drive.

**Idea for fast cable pulling** — Getting electrical service into the church addition required pulling eight 500 MCM primary cables — four to a conduit — from a pole transformer, under the street, to a meter cabinet in the church basement. To speed this and other pulling jobs, Art Myers used a Greenlee No. 765 cable puller. This versatile puller clamps directly to exposed or concealed conduit . . . pulls from any angle or position with any needed force up to 7,500 pounds . . . without straining hangers or conduit.

To get complete information on GREENLEE JOB-PROFIT TOOLING write for fully illustrated, quick-reference Bulletin E-240.

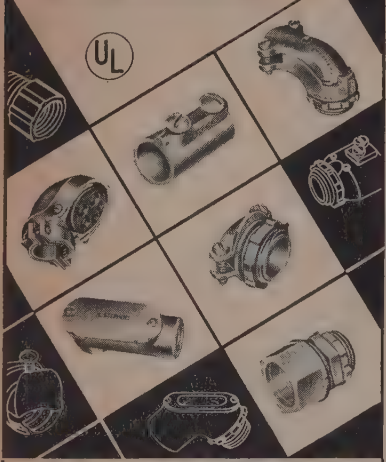
**GREENLEE TOOL CO., 1883 Columbia Avenue, Rockford, Illinois**

TOOLS FOR CRAFTSMEN
GREENLEE

# JOB-PROFIT TOOLING

**. . . cost control for contractors**

PRECISION ENGINEERED FITTINGS



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Minneapolis, Minn.

Leonard M. Slusser
318 Dooley Block
Salt Lake City, Utah

*Stanley Sales Corp.
1122 Folsom St.
San Francisco 3, Calif.

# Catalogs & Bulletins

(48) SURGE PROTECTORS for silicon rectifiers which eliminate need for extreme derating of cells are covered in Bulletin EPD 3135-1. Vickers Inc.

(49) LIGHT CONTROL and flexibility, obtained through use of four general types of lighting and 11 specific kinds of fixtures, are described and illustrated in 24-page Bulletin L758W-1, plus technical information on full line of Luxtrol light controls. Superior Electric Co.

(50) POWER CONVERTER principles and uses. Set of brochures describes static converter capable of producing symmetrical 3-phase 220- or 440-volt power from a 220-volt, single-phase source, handling from 1- to 50-hp motors. Add-A-Phase Div., System Analyzer Corp.

(51) HOME LIGHTING. Full-color 66-page catalog and lighting idea guide features pulldowns, ceiling track, pendants, pole lights, fluorescents, and recessed fixtures. Moe Light Div., Thomas Industries Inc.

(52) TRAFFIC SIGNAL controller designed for midblock school crossings. Electronic control which permits manual operation during school days is described in Bulletin 2716. Crouse-Hinds Co.

(53) SIGNAL SYSTEMS. New 88-page manual lists specifications of horns, bells, buzzers, chimes, sirens, annunciators, and other accessory equipment. Sperti Faraday, Inc.

(54) LIGHTING FIXTURES for commercial applications, including air-diffusing types and hangers for any type ceiling, are covered in new Buyers' Guide 60-C-8. Day-Brite Lighting Inc.

(55) FLOODLIGHTING. Bulletin GEA-7201, 10 pages gives application data and product information on line of filament, mercury vapor, and fluorescent units available. General Electric Co.

(56) SPLICING and terminating of rubber-neoprene cables. Step-by-step instructions for both shielded and unshielded cables are given in 30-page Bulletin 1134. Okonite Co.

(57) LOAD CENTERS. Fifteen new 150- and 200-amp twin circuit-breaker load centers are described in 16-page Bulletin GEA-7071. General Electric Co.

(58) VENTILATOR CONTROLS. Two pamphlets, F-9767 and F-9797, discuss control systems for face and by-pass units and valve-controlled unit ventilators using transistorized package controls. Barber-Colman Co.

(59) COMPOUND for protecting pole line insulators and electrical equipment bushings against excessive leakage, flashovers, and service interruptions in contaminated atmospheres is described in 4-page Brochure 4-218. Dow Corning Corp.

(60) ELECTRONIC CONTROL and power system for improving quality and lowering production costs on resistance welding jobs are covered in new brochure. Robotron Corp.

(61) TRANSFORMERS. Four examples of common step-down transformer applications are given in Bulletin 16-B01, showing method of determining proper ratings. Acme Electric Corp.

(62) BASEBOARD HEATERS in 500, 750, and 1000-watt ratings which plug together in tandem, each protected by its own thermal protector, are described in new 2-page bulletin. Meier Electric.

(63) CAPACITORS for power-factor correction. Bulletins 8146 and 8147 cover low- and high-voltage Dykanol capacitors for industrial plant use. Federal Pacific Electric Co.

(64) PANELBOARDS. New Bulletins 402, 403, and 404 describe line of fusible, fusible switch, and circuit-breaker type distribution panels. Frank Adam Electric Co.

(65) LIGHTING FIXTURES. New 60-page color Catalog 105 covers complete line of residential pendants, pull-downs, circlines, fluorescents, special-purpose fixtures, photoelectric controls, and dimmers. Progress Mfg. Co. Inc.

(66) MAINTENANCE PROCEDURES for motors, generators, and power distribution circuits, including methods of forecasting insulation life and locating cable faults, are given in Manual D-62. Associated Research Inc.

(67) LOAD CENTERS, both circuit-breaker and meter-socket type, are covered in Booklet GED-3625, 48 pages. General Electric Co.

(68) ELECTRICAL INSULATION. Catalog 36, 20 pages, gives prices and dimensions of paper-cupped coils for motor slots, transformer insulation, and similar devices. Insulation Manufacturers Corp.

# FREE—$50 IN REMCON DEVICES!

Builders, architects, homeowners—today *everyone* is looking for the little touches of luxury that make a home more desirable, more saleable. Low-voltage switching is just the "extra" that can help you provide *your customers* with comfort and convenience through electricity. And now with REMCON, the low-voltage system that's practical in any home regardless of cost, you can do it at a profit!

## WHAT IS LOW-VOLTAGE SWITCHING?

Low-voltage switching is the greatest advance in light control since the pull chain. By eliminating the need for elaborate, costly wiring, it provides the ultimate in versatility and safety through multi-point, master-control and path-of-light switching. Low voltage switching also ends shock hazard by putting only 6 volts at the switch.

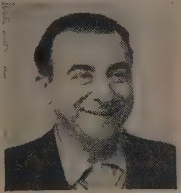
## 4 REASONS WHY REMCON IS EASIER TO INSTALL

REMCON builds the transformer *right into the relay* to make low-voltage switching easier four ways: 1. No separate low-voltage source (eliminates additional wiring); 2. No complicated systems. With REMCON, installation is as simple as connecting the three wires of the relay to the three color-coded wires of the switch; 3. No more need to run heavy armored cable from fixture to switch; in fact...4. No more switch box! Any way you look at it, there's no longer any reason to shy away from modern low-voltage wiring—especially when you think of the time, labor and money it saves!

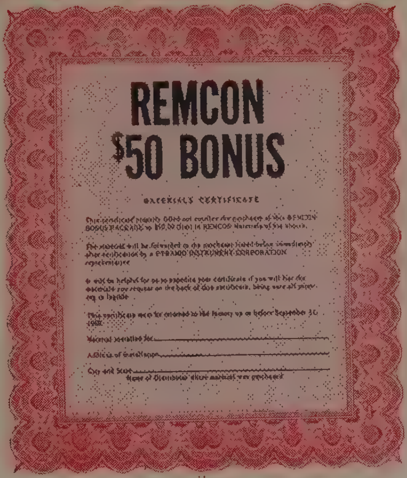
## THOUSANDS OF DELIGHTED USERS

Contractors everywhere are delighted with REMCON'S flexibility, whether they wire tract or custom homes. Read these:

"Remcon helps me provide luxury at a profit even in a $15,000 home. I can build in three- and four-way switching quickly—*at lower labor costs*—because Remcon's #18 wire *staples* to studs. I'm sold, and my tracts go just as fast." *Sidney Gotowner, Gotowner Electric.*



"Even in a custom home, small details like Remcon's pilot-light switches and hi-fashion switch plates are appreciated. Remcon plates, for example, blend with and enhance any room's decor. They're practical in *any* home." *Ephraim Berkowitz, Turnpike Electric.*



REMCON

$50 BONUS

## REMCON—THE ANSWER TO CUTTHROAT COMPETITION

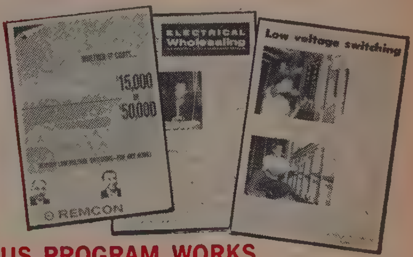
The need for contractors to "trade up" their customers is so important today that the National Electrical Contractors' Association made it the prime topic of discussion at their recent convention. How do *you* break out of the vicious circle of low bids, cheap services, poor or no profits? By offering the "plus" that pulls you away from the pack...REMCON!

## NOW ACTUALLY COSTS LESS!

Before this $50 Bonus Program, the ease of installing REMCON was more than enough to offset the slight expense over outmoded, conventional wiring. But even that's been changed. Now REMCON gives you a Certificate worth $50 in the REMCON devices of your choice—just for trying REMCON on your next job.

## REMCON SUPPORTS YOUR SELLING EFFORTS

To make it still easier for you to sell, REMCON is now in the midst of an extensive advertising and promotion campaign which includes full-page colorful ads, direct mailings to builders and architects, and an intensive publicity effort that has paid dividends in a steady barrage of articles in leading newspapers and magazines.



## HOW THE $50 BONUS PROGRAM WORKS

Go to your distributor. Buy your first package of REMCON materials (it's enough to wire the average three-bedroom house). This package will also contain: 1. A *Materials Certificate* worth $50 (list) in the REMCON materials of your choice; 2. A request form for obtaining free business cards imprinted with your name; 3. Free envelope stuffers for you to distribute to your customers; 4. Free truck decals; 5. Complete REMCON literature, including an Electrician's Manual, an illustrated instruction manual, easy-to-follow installation data sheets and wiring diagrams, and articles describing typical industrial and residential REMCON installations. You also get all new information as soon as it's issued. In addition, you will automatically be listed as an *Authorized* REMCON *Dealer*, which entitles you to our free Consultation Service—you send us your prints and we'll send back a REMCON switch layout and a list of the materials needed to do the job. The $50 Bonus Program is now in effect. Go to your distributor today!

AUTHORIZED REMCON DEALER
ALL REMCON
REMCON
LOW VOLTAGE CONTROL DOES IT
LOW VOLTAGE "Pilot Control" of CHURCH LIGHTING

All this is included in the package with the $50 certificate.

**REMCON** A Division of Pyramid Instrument Corp.,
630 Merrick Road, Lynbrook, N. Y., Dept. EC-70

Okay REMCON, sign me up as an Authorized REMCON Dealer, send me your *free Information Kit* and the name of my local REMCON Distributor. I understand I am under no obligation.

Name______________________________

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**MAIL NOW**

These fluorescent lamps may look alike . . .

but only the Westinghouse Lamp has six

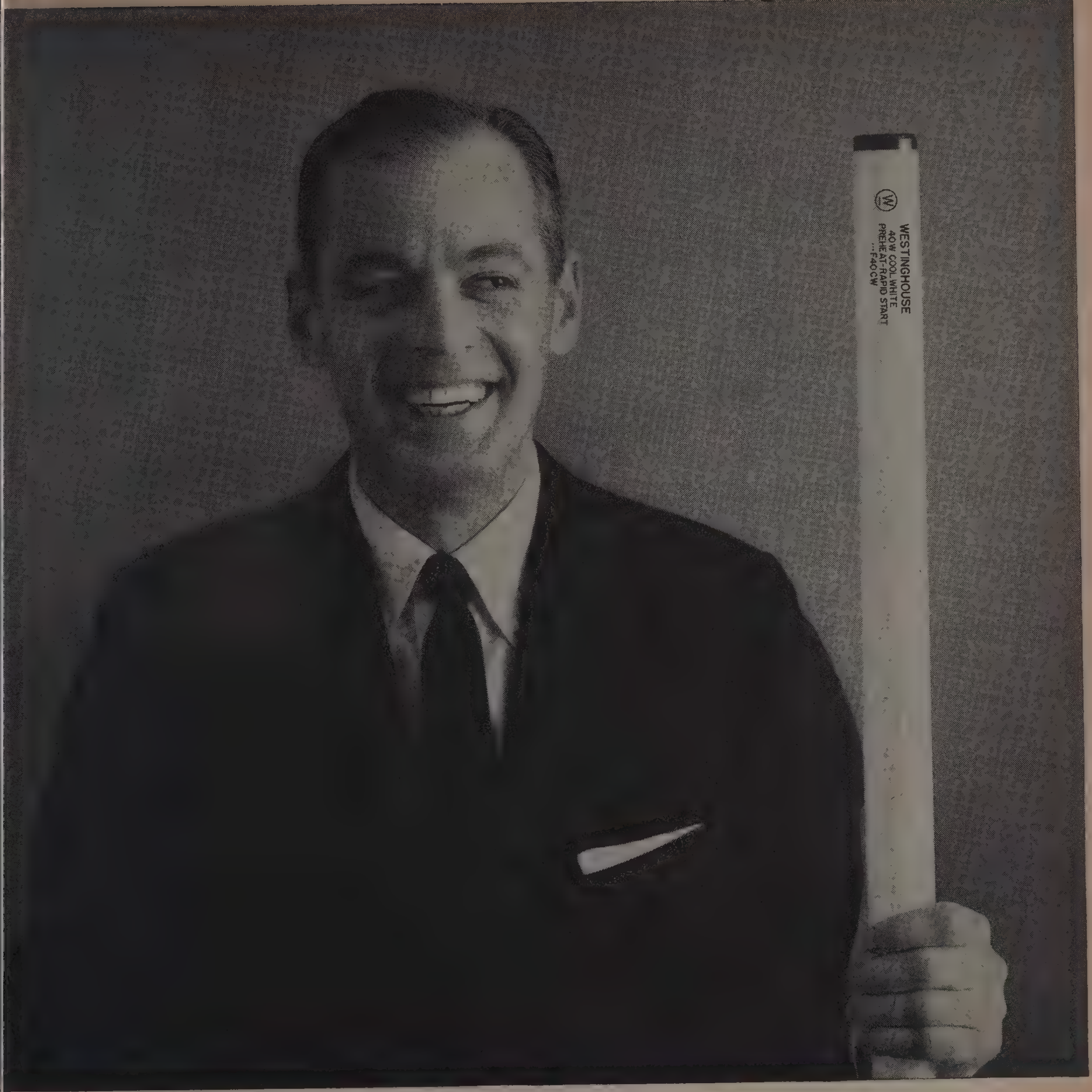
Despite similar appearance and ratings, these fluorescent lamps are *not* the same. One is a better lamp—and a better buy—because it's the only fluorescent lamp with all 6 advances described below. That lamp is made by Westinghouse. It costs you no more than any other leading brand—but it will give you years of trouble-free, efficient lighting.

**1. MORE EFFICIENT PHOSPHORS**—A special Westinghouse process selects Ultralume™ phosphor particles of a size proven to give more efficient lighting.

**2. BRIGHTER END TO END**—Lead wires are plated with super-hard Chrome Vanadium to make sure Westinghouse tubes *stay* bright, end to end.

**3. BUILT-IN "SHOCK ABSORBERS"**—Specially designed Westinghouse anodes act as buffers to cushion the terrific shock of electron bombardment and improve lamp life.

**4. "RAINCOATS" FOR RELIABLE STARTING**—Silicone "raincoats"



**important advances that make it a better buy!**

disperse moisture which can collect on exterior surfaces and prevent lamps from starting.

**5. MIXED GASES**—Westinghouse uses a precise mixture of certain rare gases, under exact pressure, to improve the light output.

**6. TRIPLE-COILED ELECTRODES**—To protect electrodes from the sudden electron bombardment when the lamp is first turned on. Emission material is quickly heated, fully protected.

**Regardless of the type or wattage of fluorescent lamps you buy, you will get better value, more light for your money, and longer, trouble-free service if you specify and insist on Westinghouse fluorescent lamps. Westinghouse makes a complete line, from tiny 4-watt lamps for instrument lighting to the giant 96-inch Super-Hi™ Lamps for store, street, and factory lighting. Contact your authorized Westinghouse lamp agent or nearest Westinghouse sales office.**

**YOU CAN BE SURE...IF IT'S Westinghouse**

WESTINGHOUSE LAMP DIVISION, Westinghouse Electric Corporation, Bloomfield, N. J.

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... another name for Quality!
SWITCH BOXES • OUTLET BOXES • BOX COVERS • FITTINGS
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Sales Representatives & *Warehouse Stocks *ATLANTA, GA. • BALTIMORE, MD • *BIRMINGHAM, ALA. • *CHICAGO, ILL • *CINCINNATI 37, OHIO • DALLAS, TEXAS • *DETROIT 2, MICH • GREENSBORO, N C • *LOS ANGELES, CALIF. • *MIAMI, FLORIDA • *NEW ORLEANS, LA. • NEW YORK CITY, N Y • NEWTON CENTRE, MASS. • *PHILA., PA. • RICHMOND, VA. • ROCHESTER, N Y. • *SEATTLE, WASH

(69) UNDERFLOOR RACEWAY systems. New catalog tells how to specify and install underfloor ducts and service fittings. Wheatland Electric Products Co.

(70) ALUMINUM CONDUIT. Advantages, dimensions, weights, and installation methods are given in new brochure. Harvey Aluminum.

(71) CIRCUIT BREAKERS with rotary handles for use on switchboards, control centers, or as individual enclosed units are covered in Bulletin 1425, 8 pages. Federal Pacific Electric Co.

(72) VARIABLE TRANSFORMERS. New 4-page bulletin describes Powerstat variable transformers up to 560-volt output, designed for fingertip remote control. Superior Electric Co.

(73) INDUSTRIAL LIGHTING equipment. Guide reviews proper selection of quality lighting, answers questions on RLM program and label. RLM Standards Institute.

(74) HIPOT TESTERS, wire sparkers, fault locators, and high-voltage test sets are covered in Catalog 60. Peschel Electronics Inc.

(75) AIR CONDITIONING and heating instruction manuals ME-131 and ME-132 deal with the installation of heating and cooling units. Chrysler Corp.

(76) TAP-OFF SWITCHES for 1-, 2-, or 3-way switching arrangements in ratings from 34.5 to 69 kv, 600 and 1200 amps, are covered in bulletin. I-T-E Circuit Breaker Co.

(77) RECESSED LIGHTING, residential and commercial, is described and illustrated in 36-page color catalog, including installation instructions, light curves, and coefficient tables. Moe Light Div., Thomas Industries Inc.

(78) SNAP SWITCHES. New catalog gives engineering data and ordering information on enclosed and open stack switches. Cherry Electrical Products Corp.

(79) CHURCH LIGHTING. Contemporary and traditional styles, plus supplementary lighting, are covered in new Catalog 74. NL Corp.

(80) TEST SETS for testing circuit breaker operation. 16-page Bulletin SB-CB-1 gives test procedure plus specifications and descriptions of test units. Multi-Amp Div., Multi-Amp Electronic Corp.

(81) LIGHTING EQUIPMENT including high-bay fixtures, shallow dome reflectors, industrial vaporite fixtures, and rear-lamped aluminum floodlights. Catalog CTC-4, 28 pages. Steber Mfg. Co.

(82) SILICON RECTIFIERS — how they create dc power savings in electrochemical and allied industries. Booklet B-7900, 20 pages. Westinghouse Electric Corp.

(83) LIGHTING catalog in 7 sections gives photometric data showing efficiency and brightness, figures for each lamp and diffuser combination. 102 pages. Lite-control Corp.

(84) INFRARED SECTIONS for electric ovens. Catalog 103, 2 pages, gives full information on oven components using G-30 type infrared lamps. Fostoria Corp.

(85) CIRCUIT BREAKERS. 70- and 100-amp 2-pole units which plug into twin load centers rated 125 amps and up are covered in Bulletin GEA-7071. General Elec. Co.

(86) GARDEN LIGHTING. Portable Floralites with 3-conductor cord sets to permit grounding of units are covered in Bulletin 135-60. Steber Mfg. Co.

(87) THEATER LIGHTING. New 101-page catalog contains layouts for 10 different performance areas, technical articles on application, and performance charts on related instruments. Century Lighting Inc.

(88) LAMP PLAN designed to build sales and profits for electrical contractors is available. Booklet includes tips on how to build the entire business through lamp sales plus data on lighting maintenance and group relamping opportunities. General Electric Co.

(89) TERMINALS for Type P 10-amp rotary switches designed for quick connection are described in Bulletin 20. Electro Switch Corp.

(90) SHEET MICA products. Catalog 26, 24 pages, presents technical information on mica hard plates, flexible combinations, rolls, sheets, and tapes. Insulation Manufacturers Corp.

(91) TAPES — pressure-sensitive, Fiberglas, and silicone rubber. Information to help solve extreme high-temperature electrical and mechanical design problems is presented in TEMP-R-TAPE brochure. Connecticut Hard Rubber Co.

(92) VARIABLE-SPEED DRIVE systems consisting of operators' control station, electronic control panel, and dc drive motor are described in Bulletin 101. Louis Allis Co.

# EASIER TO DO... and costs less too!

# B-M

## INDENTER FITTINGS and TOOLS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

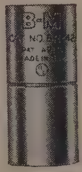
A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.

**Red Throat**
**BM-21B**
½″ Connector

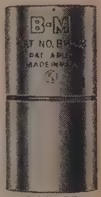
**Red Throat**
**BM-22B**
¾″ Connector

**Red Throat**
**BM-23B**
1″ Connector

**BM-41**
½″ Coupling

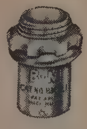


**BM-42**
¾″ Coupling



**BM-43**
1″ Coupling

**BM-51**
½″ Offset Connector



**BM-21**
½″ Connector

**BM-22**
¾″ Connector

**BM-23**
1″ Connector

**BM-No. 600**
Changeable Jaw Indenter

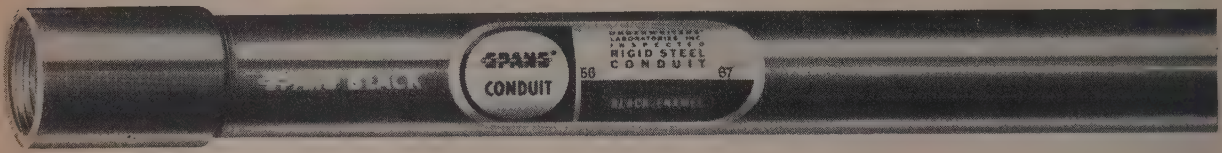
**BM-No. 1000**
Handvise for ½″, ¾″ and 1″ E.M.T.

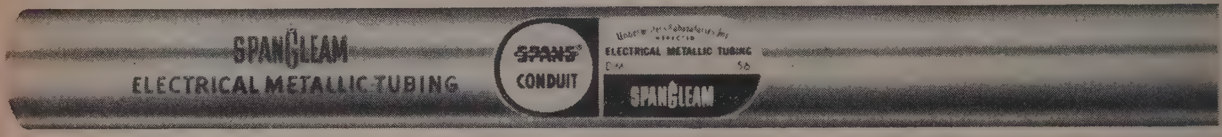
**BM-No. 100**
Cutter for ½″, ¾″ and 1″ E.M.T.

**BM-No. 607**
½″ Indenter
**BM-No. 608**
¾″ Indenter

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

**BRIEGEL METHOD TOOL CO.**
GALVA • ILLINOIS

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ELECTRICAL METALLIC TUBING
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SPANGLEAM

# the top-quality SPANG® Conduit Line . . .

. . . of SPANG rigid steel conduit and electrical metallic tubing has earned a reputation over the years as the top-quality conduit line for fast, efficient, economical and trouble-free electrical wiring protection.

# now includes SPANG® Aluminum Conduit!

Good news for you! SPANG now offers top-quality SPANG Rigid Aluminum Conduit to provide you with a new complete line of SPANG Conduit Products. SPANG Rigid Aluminum Conduit, Couplings and Elbows are available in a full range of sizes from ½″ through 6″.

SPANG rigid steel conduit, electrical metallic tubing and rigid aluminum conduit are all produced under strict quality-control methods, thoroughly tested and inspected before shipping, and packaged for convenience and safety—assuring you of a top-quality, uniform conduit for every type installation.

For those installations where engineering dictates the use of rigid aluminum conduit, you can now give consideration to SPANG Rigid Aluminum Conduit with the same confidence as you would consider any SPANG Steel Conduit product. They're *all* top-quality!

Your local SPANG Distributor is looking forward to providing you with one-stop service for all your conduit needs. He has the complete line of SPANG Steel and Rigid Aluminum Conduit Products, and he's always prepared to give you top-quality service. Give him a call!

SPANG® CONDUIT

**THE NATIONAL SUPPLY COMPANY**

Two Gateway Center, Pittsburgh 22, Pennsylvania
Subsidiary of Armco Steel Corporation ARMCO®

# Reader's Quiz

**QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.**

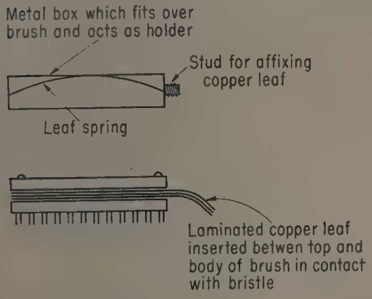
## Crane Grounding

*QUESTION X37—We use 3-phase, 440-volt hoists with 110-volt pushbutton controls on a traveling crane over paper machines. Power pickup is from trolley wheels on three open wires.*

*This crane may stand idle several days at a time, and the track collects dust and moisture and rusts; so the help gets a considerable shock at times off the pushbutton and lift chains. Solid grounding of the crane is not very feasible.*

*Would an isolation 1 to 1 transformer on such a circuit help much? I have thought perhaps an isolation transformer with a condenser and high resistance in each leg to ground might be a cure. If so, how much current would I have to leak to ground?—R.P.H.*

ANSWER TO X37—In the paper mill where I work, we encountered a similar problem. We solved it by using brass grounding brushes as per sketch. These brushes serve two-fold purposes; first, they provide a ground path from the equipment to the track and second they tend to clean the track of all dust, rust, etc., as they brush over it. Also, be sure that the grounding conductor and lug provide a low-contact resistance where this connection is made to the track.—H.J.D.


Metal box which fits over brush and acts as holder
Stud for affixing copper leaf
Leaf spring
Laminated copper leaf inserted betwen top and body of brush in contact with bristle

ANSWER TO X37—From the description of the symptoms given, one should strongly suspect the presence of static electricity. If such is the case, capacitors and isolation transformers in the electric power circuits will not provide the answer.

Static electricity is produced by the action of contact and separation of dissimilar substances, one of which is an insulator. This latter could correspond to the rust accumulation described in the question. Contact of these substances causes electrons to flow at each contact point, resulting in a potential difference between the two substances.

Some of the conditons which affect the amount of charge are speed of separation of the substances, surface smoothness, area of contact, temperature, humidity, and amount of motion.

To test for a suspected electrostatic charge, use a neon tube type circuit or a spark plug tester. The leads of the tester are held at the point where a static accumulation is suspected, and if present, a glow or spark will occur in the neon tube. Other detecting devices which can be used are the gold-leaf electroscope and the electrostatic voltmeter.

This static charge can be removed by properly installing devices such as a grounded wire used as a "brush," electrostatic grounding "combs," or a grounding "tinsel bar." Another possibility would be the addition of a fourth trolley wire and collector brush to provide a continuous grounding circuit. If the open trolley wires were to be replaced by an enclosed trolley duct, it would be possible to effectively tie together all trolleys and duct casings to the different moving surfaces of the crane, thus providing a grounding path for the elimination of the static charges.—R.G.W.

ANSWER TO X37—You may suffer from static elecricity caused by moving paper or by leakage from the 110- or 440-volt circuit. A solid ground between all the loose metal parts will blow a fuse or remove the static. The 1 to 1 transformer will not work because if one section of metal touches wire A, and a second wire touches metal item B, then somebody will get a shock.—H.S.

## Circulating Neutrals

*QUESTION Y37—An installation has a 240-volt, 3-phase, 3-wire system to accommodate the general purpose power requirements of three adjacent buildings. In building A is a center-tapped autotransformer connected between lines 1 and 2 with its neutral grounded to supply 120/240-volt, single-phase, 3-wire service in this building. Service to building B is provided in the same manner, except the transformer is connected between lines 2 and 3. Building C is similarly equipped, but connected between lines 3 and 1, so as to distribute the total load among the three phases. This system was installed and placed in service and has been in use for many months.*

*With the 120/240-volt, 2-pole main switch in building A open, the autotransformer neutral was disconnected and some fireworks resulted.*

*Why did this occur inasmuch as the main switch was open?—R.D.A.*

ANSWER TO Y37—In an installation such as described, a potential difference of 120 volts will exist between the midpoints of the three autotransformers. When these three midpoints are grounded as described, a current will flow between them. The magnitude of the current will be limited only by the resistance of the path between the grounding electrodes. To eliminate this condtion, two-winding transformers rated 240 on the primary and 120/240 volts on the secondary should be used in place of center-tapped autotransformers. The installation as described is a violation of Section 200-4 of the National Electric Code.—D.J.N.

ANSWER TO Y37—The trouble with such a hook-up is that the grounded center-taps of the autotransformers connected to different phases cause ground fault currents. The three autotransformers connected as described constitute a delta-connected load and as such there is 120 volts between any pair of center taps. Since each center-tap is connected to a ground electrode, fault currents flow according to the conductances of the ground electrodes.

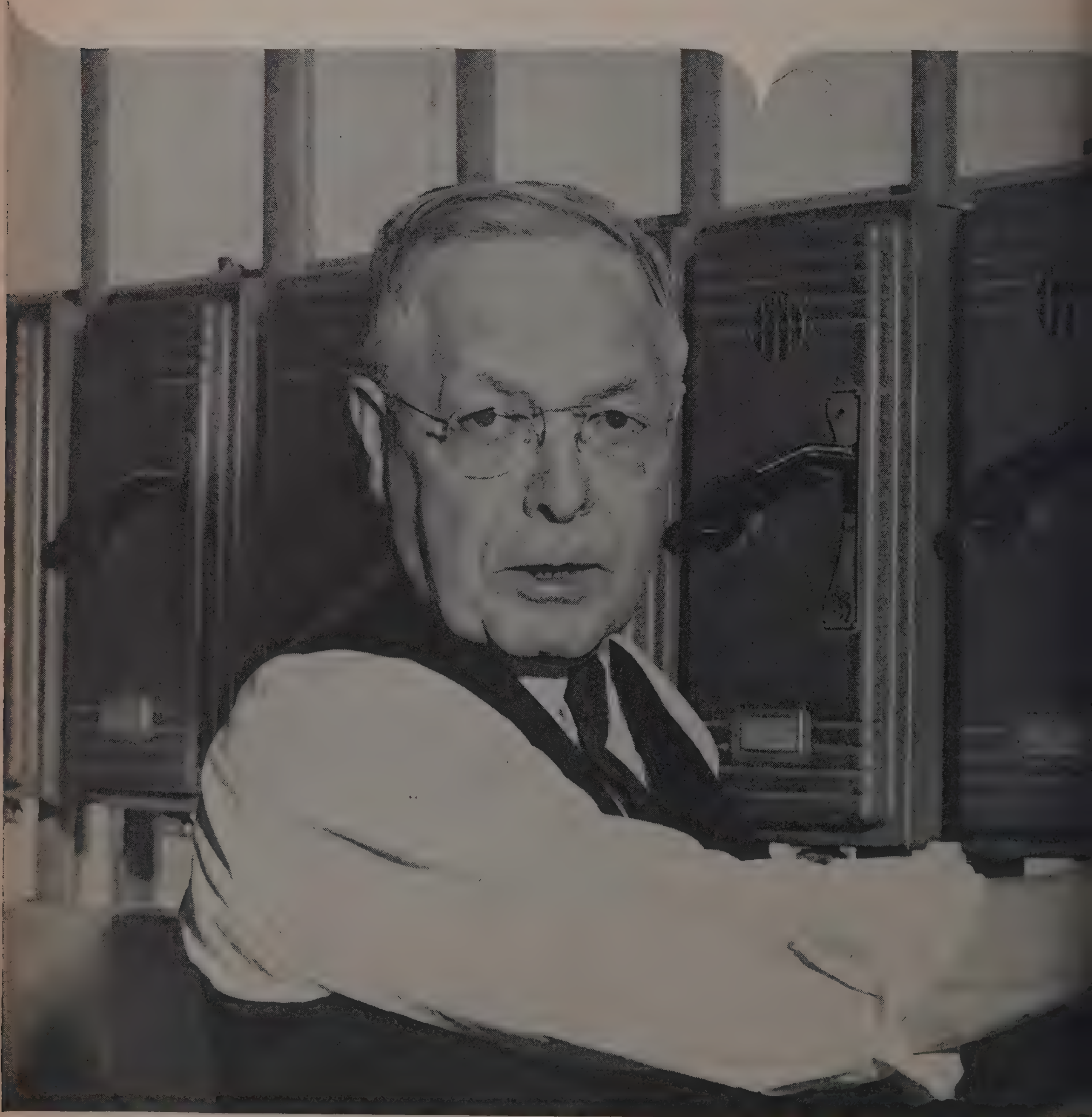
The "fireworks" probably occurred because the grounding connection to the neutral was on the load side of the point being disconnected and thus broke the fault current. Two-pole switches on the

# “Those young fellows

“They think they’re the only ones who know about circuit breakers. Why, by golly, you don’t have to be young to be smart. And you don’t have to be old to be old-fashioned, either.

“Fact is I switched over to circuit breakers before a lot of the young fellows did. Now when I have a new circuit to put in, I *always* use a circuit breaker. That is, for lights, bench outlets, machines, motors . . . all the things we need electricity for in this plant.

“I should think everybody today would know how circuit breakers cut down the time loss when electricity goes out . . . how easy they make it to restore power . . . and how safe they are.



# can't get ahead of me"

"One guy I know claims circuit breakers are too expensive. Why, nothing's cheaper than a circuit breaker. Just have one overload and you'll discover that. Have very many and your circuit breaker pays for itself, and then some.

"What brand circuit breaker should a fellow insist on getting? Well, ask around. See if you can find anybody who doesn't agree that I-T-E is the best."

Send for the new, free bulletin on how circuit breakers can benefit industrial plants. Or see your distributor. I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.

**I-T-E CIRCUIT BREAKER COMPANY**

Facts of Light!
CHAMPION Lamps

TUBES ARE MORE ECONOMICAL THAN BULBS BUT —

For lighting systems in general, incandescent lamps have a relatively low initial cost and a relatively high operating cost. Just the reverse is generally true for fluorescent lamps. In the long run, fluorescent lamps prove the most economical. In the average school building, for instance, fluorescents begin to be more economical in from 3–4 years. However, incandescents would provide the most light for an initial expenditure.

1910 $1.45 1960 .25

LIGHT BULBS ARE A BARGAIN!

50 years ago a 100 watt bulb cost $1.45. In fact, if 1910 production methods attempted to supply today's demand, a 100 watt bulb would cost about $4.10. Today, you can buy a much better 100 watt bulb for 25 cents list.

THE "7500 HOUR" RATING OF A LAMP DEPENDS ON HOW OFTEN YOU FLICK THE SWITCH

When a fluorescent lamp is rated at 7500 hours, the manufacturer bases this life expectancy on the assumption that the lamp will burn three hours for every time it is started. If you burn it ten hours per start you will increase its life roughly 50% to about 11,250 hours. On the other hand, one-hour per-start operation will shorten its life to about 5,250 hours.

MANY COST-SAVING HINTS IN THE CHAMPION LIGHTING MAINTENANCE MANUAL

This manual explains the principles and advantages of good lighting practice in 48 pages. Included are sections on group replacement of lamps, cleaning programs and a guide to trouble shooting fluorescent installations. This is the latest edition of a guide that has proved to be of great practical value to lighting men everywhere. Write for a free copy.

CHAMPION LAMP WORKS, Lynn, Massachusetts
CHAMPION INCANDESCENT-FLUORESCENT • YOUR BEST BUY IN LAMPS

load side of the autotransformers have no effect on these ground currents.

The hook-up in question results in a needless waste of electricity and would likely overload the autotransformers as well as being hazardous. Suppose the buildings are of metal construction and that the neutrals are bonded to the buildings. This would cause a voltage difference of 120 volts between buildings. Imagine the surprise awaiting a workman attempting to string a metal clothes line wire between buildings!

Replacing the autotransformer in each building with a conventional two-winding transformer will provide the necessary isolation between neutrals. With the 3-wire, 3-phase system as supplied, autotransformers should not be used at all to secure 120-volt branch circuits unless one of the phase wires of the supply system is solidly grounded with no switches or fuses and this grounded conductor is carried through and common to all 120-volt circuits.

Incidentally, if the two-pole switches were located on the line side of the autotransformers there would be no "fireworks" when disconnecting the neutral, although the switches would be breaking one-half the fault current amps due to autotransformers action. However this is not a solution to the problem as it would not effect any changes while in operation.—R.B.F.

ANSWER TO Y37—From the text of the question the installation must have been connected much as shown in Fig. 1. However, R.A.D. does not indicate whether or not the supply bank of transformers contains a ground. If we assume there is no ground at the main bank of transformers grounding the center of the autotransformer "A" converts the system to an ordinary delta-connected 4-wire system with line No. 3 the "high" leg. However,

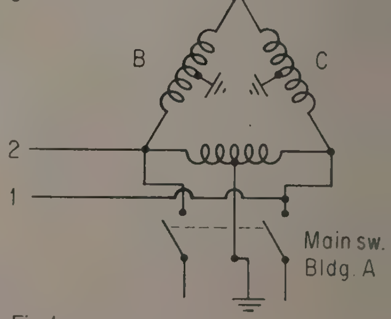


Fig.1

**LUKENS STEEL COMPANY'S NEW ELECTRICAL FURNACE** draws power from the new Brandywine main substation by 15kv, single conductor, 600 MCM Okolite-insulated cable in underground ducts. New furnace is part of Lukens' plant expansion program, designed and constructed by United Engineers and Constructors Inc. of Philadelphia.

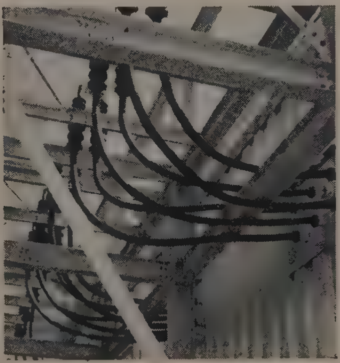
# How Okonite Cable'bility protects plant profits at Lukens Steel

**Cable'bility** (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

ns Steel Company, like thousands of leading corporations ghout the world, makes extensive use of Okonite Cable'bility. ns has found that long-lived, dependable Okonite cables are pensable on important applications to maintain profitable pro- on—an assurance based on the excellent service records of ite cables in their own and other plants.

onite cables will meet *your* most challenging specifications long-lasting protection, maintenance-free service. This is typi- by the proved service record of Okolite insulation—used by ns Steel for its critical high voltage feeders. This insulation has year record in all types of installations demanding resistance zone, moisture and heat, as well as high dielectric strength.

**NATION'S LARGEST ROLLING MILL**—Lukens' 206-inch mill is a good example of essential mass production equipment whose continuous operation is assured by the use of Okonite cables in crucial power circuits.



**LUKENS' BRANDYWINE SUBSTATION** steps down power for the existing Lukens plant and proposed expansion. From this key substation the main feeder for the expansion is Okolite-insulated cable for 23kv ungrounded service—a tribute to Lukens' past experience with Okonite cables.

Send for more information about this long-lived, widely used insulating material and its applications. The Okonite Co., Subsidiary of Kennecott Copper Corp., Passaic, N. J.

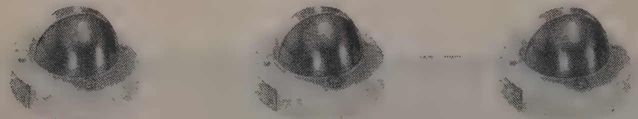
*where there's electrical power . . . there's* **OKONITE CABLE**

**Fire detection is big business! Cash in now with Kidde equipment!**

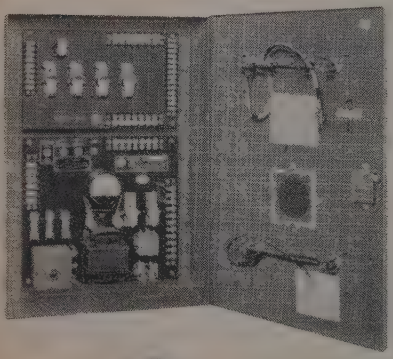
For years, schools, public buildings, businesses and homes have been waiting for an inexpensive, dependable fire detection system approved by U.L. and F.M. Now you can sell them this vital detection system at a reasonable price. When you sell a Kidde fire detection system and install it yourself, there are thousands of dollars in potential profits for you.

And, selling Kidde, you can be sure that you're selling quality. For more than 30 years, Kidde has been the leader in fire safety. It's a name you and your customers can trust!

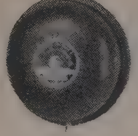
Find out more about Kidde fire detection components—and how you can use them to cash in on these most profitable markets! For more details, write Kidde today.



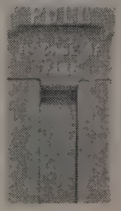
Kidde Fyrindex detectors. Self-resetting, fast-acting, easy to install. Fixed-temperature units each protect up to 225 sq. ft. Rate-of-temperature-rise models protect to 900 sq. ft. Combination rate-of-rise, fixed-temperature units each protect 2500 square feet. All U.L. and/or F.M. approved.



Control, rectifier, zone annunciator panels contained in one cabinet. Monitors up to ten zones. 12 or 24 v., dc.



Kidde weatherproof alarm bells — 6", 8", and 10" diameter. U.L.-approved.



Manual alarm pull for one or more stations.

**Kidde**

Kidde Ultrasonic & Detection Alarms, Inc.
785 Brighton Road, Clifton, New Jersey

A Subsidiary of Walter Kidde & Company, Inc., Belleville 9, N. J.

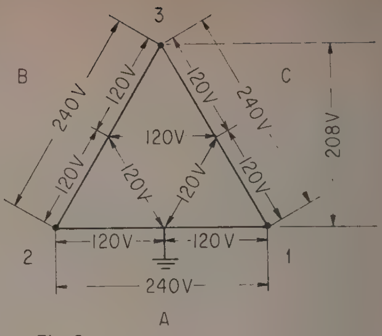


Fig. 2

we cannot ground any other point on the autotransformers "B" or "C" as long as the center of "A" is grounded without finding a difference of potential between our ground points.

We can see from the vector diagram of Fig. 2 that all three center tap connections are at different potentials.

In other words there exists a 120-volt short circuit between the grounded center taps of transformers "A," "B," and "C." Possibly the only reason the primary fuses did not blow is because of high capacity of the system and low conductivity between the grounding electrodes (probably driven grounds). In any case a great deal of energy is being wasted in circulating currents between the grounding electrodes.

If it is necessary to connect the system for balanced 3-phase with 120/240-volt 3-wire service to each building it will be necessary to use the circuit shown in Fig. 3.

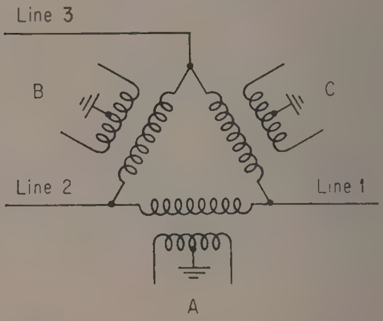
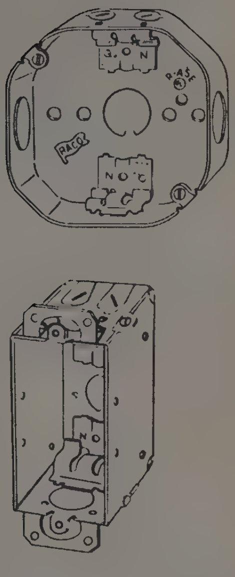


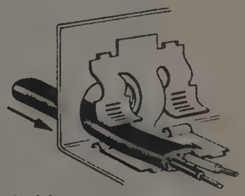
Fig. 3

This may be done with 1:1 isolation transformers on the present secondary service or with three separate transformers on the primary lines. One phase of the supply bank may already be grounded at its center, in which case it would be necessary to use only two isolation transformers if the 1:1 configuration is used. Consult your local utility company but don't continue to use the system as it is now installed.—R.G.



RACO switch and outlet boxes also available with "Q" Quick-Clamps.

# New RACO "Q"* Quick-Clamp now available in Beveled Corner boxes



Cable moves freely into clamp and is tightly gripped.

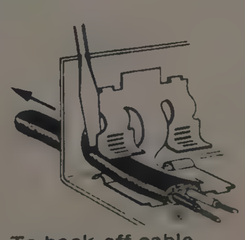
RACO's revolutionary new "Q" Quick-Clamp that lets you install non-metallic sheathed cable in seconds . . . with no screws to tighten . . . is now available in complete line of RACO beveled corner boxes, too!

The new "Q*"$_B$ Quick-Clamp for beveled corner boxes has the same time and money saving advantages as the original "Q" Quick-Clamp introduced last year:

1. Simply push cable into "Q" Quick-Clamp . . . no screws to tighten . . . no threads to strip.
2. Pull cable into clamp to any length desired.
3. To back cable out of clamp, or to shorten your lead, apply a little pressure under clamp with a screwdriver and pull cable back.

The new "Q" Quick-Clamp grips cable tightly . . . it can't be pulled out . . . exceeds Underwriter Laboratories' tests (fully protected by patents). Get the new "Q" Quick-Clamp switch and outlet boxes now at your RACO Distributor.

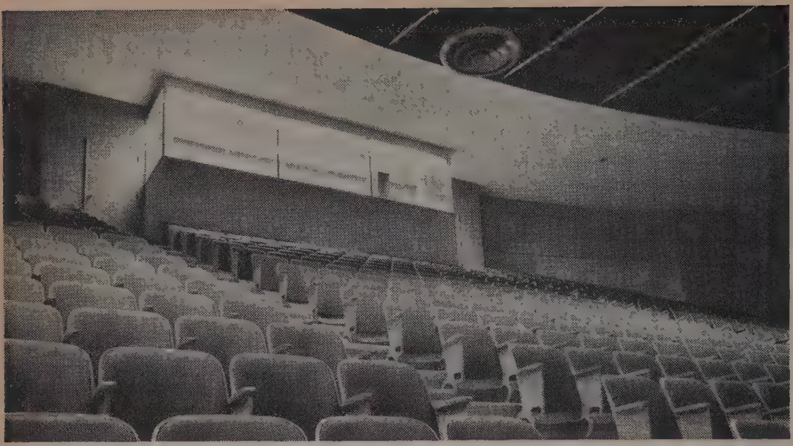
*T.M.



To back-off cable, release clamp pressure with screwdriver.

RACO

**ALL-STEEL EQUIPMENT INC.**
AURORA, ILLINOIS



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The choice of a Stromberg-Carlson sound reinforcement system for the new Memorial Auditorium in Utica, New York, assures complete coverage of the entire building—and much more.

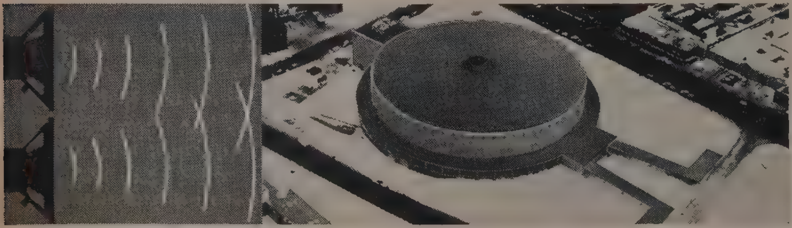
The system is wired for stereophonic sound, bringing to audiences the full, realistic richness of sound in three dimensions. The system is versatile enough to provide any kind of programming and sound distribution, including tape, records, and broadcast material. Strategic placement of wide-range speaker systems assures precisely the right kind of reinforcement for any event. A separate paging system provides coverage throughout the building.

All these custom features are built into a system custom-engineered of *standard* Stromberg-Carlson components. And this flexible, economical arrangement is available to meet the needs of *your* customers in new or existing construction.

*More and more contractors are swinging to Stromberg-Carlson sound and communications equipment because they have learned that the assistance and service rendered by Stromberg-Carlson sound distributors make installation easier and require fewer contractor man-hours.*

When you bid Stromberg-Carlson, you bid competitively—with assurance of a good profit and an installation that will add to your prestige.

For further details, or the name of our local representative, write to Special Products Division, 1453-07 North Goodman Street, Rochester 3, New York.



Among the unusual custom features of the Stromberg-Carlson sound reinforcement system in the Utica (New York) Memorial Auditorium is stereophonic sound reproduction. Electrical contractor: Langdon & Hughes Construction Corporation of Utica.

*"There is nothing finer than a Stromberg-Carlson"*

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS

## Autotransformers

*QUESTION Z37—We are confronted with the fact that one-half of a mine has 460 volts ac and an older portion 230 volts ac, both 3-phase, 60-cycle. Rather than change the hard-to-get-at taps to change motor connections on the welding machines, we are planning to install autotransformers to step down the voltage permanently for the instances where a quick change of welders is in order.*

*In Fig. 1 note that the primary and secondary winding are tied together electrically. Having no experience with the idea, the question is are there any objections by the readers who have used the circuit?*

Fig. 1

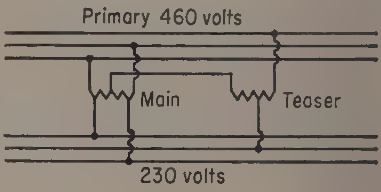
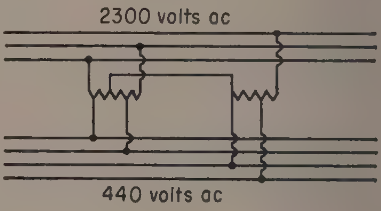
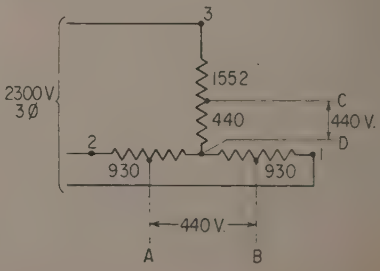


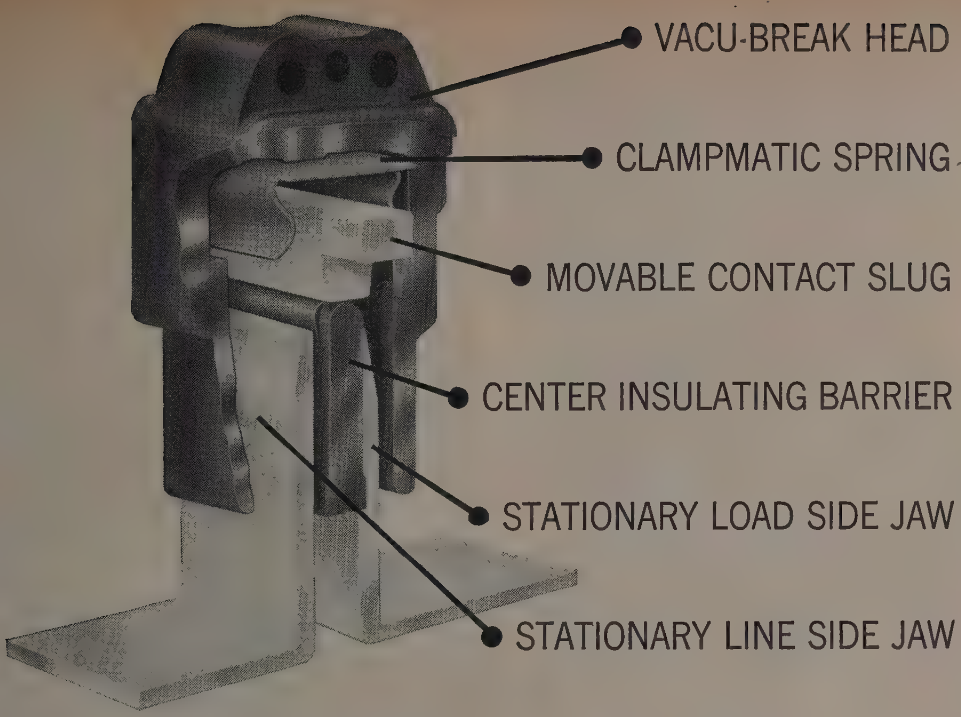
Fig. 2



*Again stuck with two systems because of the age of parts of the mine, is Fig. 2 orthodox in converting from a 3-wire, 3-phase primary to a 4-wire, 2-phase secondary current required for transformer-type welders? It will balance the load equally on the primary, we hope.*
*—P.C.Z.*

ANSWER TO Z37—From your use of autotransformers, I'm wondering if you are related to R.D.A. who asked question Y37. Your Fig. 1 will work all right, but you can get into trouble with Fig. 2. A look at the following diagram will explain this:





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Your customers get longer switch life from BullDog safety switches, thanks to unique BullDog design. The high-tension Clampmatic® spring puts pressure where it belongs—on contact faces after the switch is "ON." Clamped pressure action assures good electrical contact for the life of the switch. It means the switch lasts longer, too, for there's no overheating to damage switch components. In switching "OFF," the pressure's removed before the "break" . . . providing true quick-break action.

Vacu-Break® design is another reason BullDog safety switches last longer. Switching contacts are completely enclosed in the Vacu-Break head. Arcs are restricted, starved of oxygen, cooled and smothered quickly. In addition, Vacu-Break *double*-breaks the circuit, effectively reducing the arc length and arcing time.

Vacu-Break arc control plus clamped pressure contacts add up to long switch life . . . and dependable, economical service for your customers. You'll find BullDog safety switches need little or no maintenance over years of heavy-duty use. See your BullDog products distributor.

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NOW YOU CAN GIVE YOUR CUSTOMER A BETTER SPLICE WITH HALF THE EFFORT WITH ANACONDA DURASHEATH HIGH-VOLTAGE CABLE

has a new, clean-stripping, semi-conducting tape

**OBLEM:** To make a sound, safe, high-voltage splice, ery last speck of semi-conducting tape material must removed from the insulation . . . if traces remain, ances are the joint will eventually fail. But—this imrtant step requires tedious scraping and buffing.

**LUTION:** The new Anaconda-developed *clean*-strip ng, semi-con tape, which is an exclusive feature of rasheath Cable. The photos (left) were taken imediately after semi-con tapes were stripped off the sulation. It takes much longer to get other cable sulation surfaces as clean. That's why this exclusive ature makes splicing a great deal easier.

The planned research and production program hich brings you this outstanding cable development also responsible for the equally important developents in Butyl rubber insulation compounding and truding—which have produced the best possible balanced design and construction in high-voltage rubber-insulated cable obtainable today—Anaconda Durasheath.

For additional, more technical information about Anaconda Durasheath, write for Anaconda Bulletins DM-5903, covering Durasheath High-Voltage Cable, and DMS-5566, -5720 and -5735, dealing with the Splicing & Terminating of Durasheath Cable. Contact your nearest Anaconda Wire & Cable Company District Office, or write to 25 Broadway, New York 4, N. Y.

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These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

*Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.*

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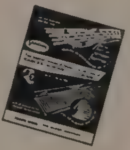

Get a ground on one of your 2300-volt phases and you will get some high voltages to ground on the 440-volt lines that can break down insulation and kill some one. Ground line 2 for instance, then you have the following voltages to ground on 440-volt lines A, B, C, and D.

A to ground — 930 volts
B to ground — 1370 volts
C to ground — 1230 volts
D to ground — 1150 volts

I recommend you use two winding transformers (a primary and secondary winding that are separate) to go from 3-phase 2300 to 2-phase 440 volts—W.E.G.

## Comment

Question L37 of our April 1960 issue was as follows:

"We have recently had a lot of trouble with one of our motor starters. Starter is a 7½ hp combination type motor contactor and fused disconnect. We have been having trouble with the starter not dropping out when the stop button is pushed. This doesn't happen all the time, but happens enough to give us considerable trouble. This motor operates a feeder to a conveyor belt, so it is important that the feeder shut down when the belt stops. We suspect it is due to the control cable having an induced voltage in it, causing it to hold the starter in. The pushbutton and interlock are connected to the starter with 1000 ft of 3-wire tirex cable strung on a messenger cable. The power cable for the starter is also strung on the same messenger and is a 4-wire tirex cable. There are also a number of other cables of the same type strung on this messenger supplying other feeders. I would appreciate some advice on how to cure this trouble."

The answers published prompted a letter from an industrial control expert. His comments, which add valuable supplemental information to the solution of the question, are as follows:

"The real problem is associated with the conductor-to-conductor capacitance in the long control wires in combination with a small motor starter whose magnet coil will reflect a high inductive reactance in the closed position. The physical circuit involved is as shown in Fig. 1.

Opening the stop button at the end of the 1000-ft control cable produces the circuit condition displayed in Fig. 2. The magnet coil can con-

New Century Electric motor provides low-cost power for fans, blowers, pumps and compressors.

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This new motor . . . at either 1200 or 1800 rpm's . . . will give smooth, cushion acceleration. No cogging, jerking or jarring equipment. Just dependable starting power with the same reduction in starting current of all Century Electric part-winding motors. A special winding scheme makes this extra smooth start possible.

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**Reliable power**—High quality construction features include . . . coils insulated with tough polyvinyl acetal resin . . . windings dipped and baked with several coats of high temperature synthetic varnish which protect against oil fumes, mild acids, dust and grit . . . rotors dynamically balanced so motors run smoothly and quietly . . . rugged cast iron frame for long life and low noise level. Century part-winding start motors are available in 20 to 150 hp sizes and in speeds of 1200 and 1800 rpm.

**Application aid**—A Century Electric application engineer will be glad to discuss your part-winding start problems with you. Century Electric also makes a complete line of motors . . . all sizes and types from 1/20 to 400 hp. For a copy of the new Century Electric Motor Application Guide, please write for bulletin 270A. For *more* than a motor . . .

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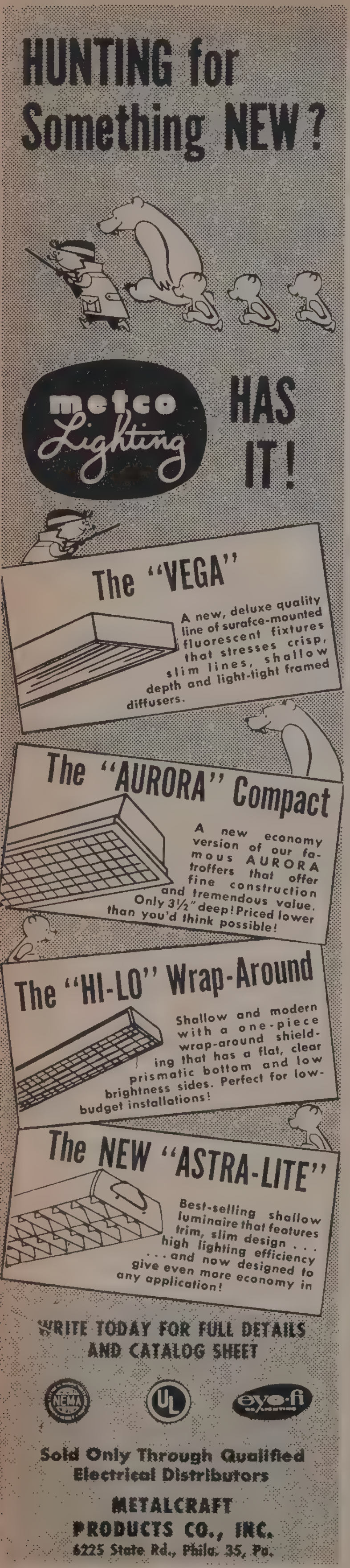

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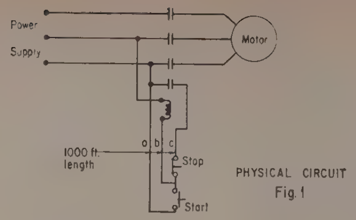
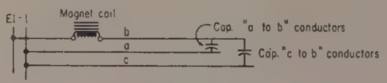
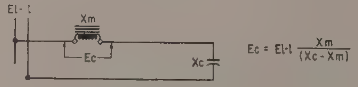


PHYSICAL CIRCUIT
Fig. 1



CIRCUIT FORMED BY PUSHING "STOP" BUTTON
Fig. 2



ELECTRICAL EQUIVALENT OF FIG. 2
Fig. 3

tinue to be energized through the control conductor coupling capacitance. The equivalent electrical circuit formed is shown in Fig. 3. $X_m$, the inductive reactance of the magnet coil (in the closed position) can be thousands of ohms. A small magnet coil (small size starter) and a high operating voltage (say 440 volts) makes for a high value of inductive ohms. The actual value could well be 10,000 ohms or more. The capacitive coupling in a 1000-ft length of control conductors could be of the order of 0.1 mfd or an equivalent 60-cycle capacitive reactance of about 25,000 ohms.

"With values of 10,000 ohms for $X_m$ and 25,000 ohms for $X_c$, the voltage across the starter magnet coil when the stop button is pushed (see Fig. 3) would be:

$$E_c = E_{L-L}\,\frac{(X_m)}{(X_c - X_m)}$$

$$= E_{L-L}\,\frac{(10{,}000)}{(25000-10000)} = 2/3\ E_{L-L}$$

"It can be expected that $\frac{2}{3}$ of rated voltage (or higher) will be sufficient to hold the magnet closed preventing drop-out of the starter.

"The simplest solution is to connect a shunting resistor in parallel with the magnet coil in the starter. For a 1000-ft control cable length and a size 2 or 1½ starter, perhaps 440 or 550 volts, connection of a 5000-ohm shunting resistor (100-watt thermal capacity is ample) will cure the trouble without need for further checking. There is no need to more exactly examine the circuit shown in Fig. 3 to determine how much higher the resistance value might be and still be effective. If the reader's system includes a large number of such installations of the same type, a more exact analysis might be warranted."—R.H.K.

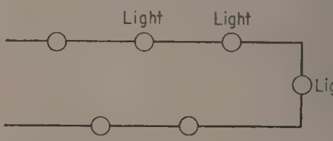
## *Can You Answer These QUESTIONS?*

**QUESTION H38**—What might be the most reasonable way of signaling on a machine before the magnetic switch trips under an overload condition? This should be accomplished before the tripping point so the feed to the machine could be reduced. I have used an extra heater block in the load circuit which has a thermal heater of a smaller value than the ones in the magnetic switch. Then the contacts are reversed so they make contact as the load comes to a pre-determined value. This causes the alarm circuit to be completed. The reset is made automatic by removing the catch so it will open the contacts as the load is decreased. Would like to hear of other methods used. —E.S.H.

**QUESTION J38**—We recently experienced a major short circuit on our 4160-volt distribution system and the short was cleared by an oil circuit breaker. We suspected that the oil had become damaged by the extensive arc, but we had not effective means of testing this oil.

Has anyone had any experience with short circuits similar to this? How does one go about testing this oil? And finally, can the insulating properties of the oil be destroyed by an arc?—J.A.M.

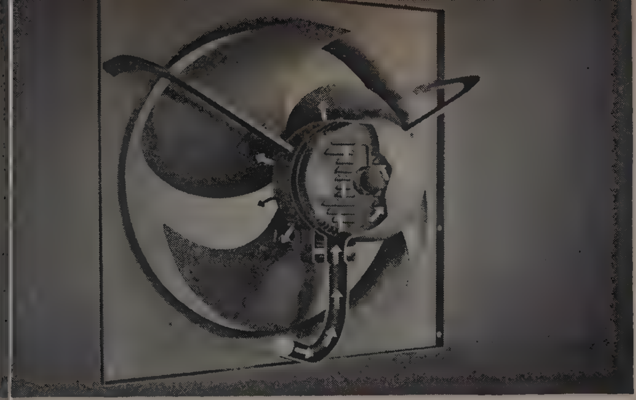
**QUESTION K38**—I have a 6.6-amp constant current series street lighting system with three separate circuits. The cable used is a single conductor of the direct burial type. On one of these circuits, there now exists more than one ground which I have been unable to locate. The cable layout in this circuit requires two single conductors running in the same ditch as per drawing:



This method of laying the cable has rendered the use of my fault locator useless for one cable cancelled out the other.

How can I pinpoint these grounds?—J.F.

**PLEASE SEND IN YOUR ANSWERS BY AUGUST 15**



***ol, Clean, Quiet.*** Vent pipe sucks in outside air, *pressure-cools* manently lubricated Ilg-built motors—designed to provide op- ting cost advantages of *open-type* motors plus the protection of *ally enclosed* types.

***"Check-Out" Time.*** Every Ilg-built propeller fan wheel must pass rigid dynamic balancing "checks" before being direct-connected to Ilg-built self-cooled, 3-phase or permanent split-capacitor, single-phase motor.

# New ILG Square Panel Propeller Fans move up to 37,550 CFM

You're looking at the new Ilg Type PF square panel propeller fans. Note the sturdily constructed 14-gauge steel mounting panel; the deep-throated streamlined orifice that increases fan efficiency; the choice of fan wheels—airfoil design blades (either five or nine) for operating against higher static pressures, and Ilg's patented Type "Q" blades for super-quiet operation on ordinary requirements.

Choice of three sizes: 36-, 42- and 48-inch fan wheels. All fans feature Ilg self-cooled motors, direct-connected, permanently lubricated. And all bear the Ilg "One-Name-Plate" pledge of performance. Write for Bulletin DB1-106.

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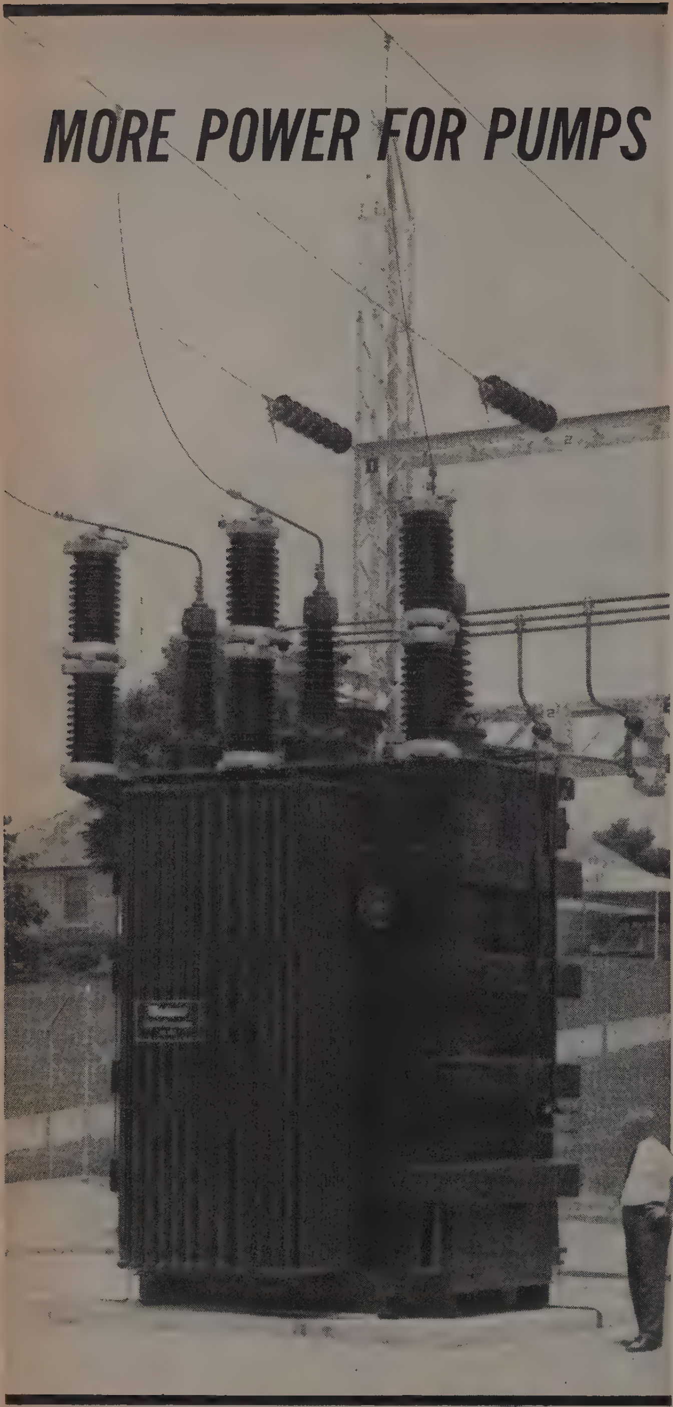

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The Plantation Pipeline Company pumping station at Neese, Georgia, is part of an underground transportation system that pushes high quantities of petroleum products to their market.

The Neese operation was originally served with power from a 44 kv system substation. However, the size of the pumping load—which includes some 1800 hp motors—became too great for the substation to handle adequately.

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# Questions on the Code

*Answered by:*

**B. A. McDONALD,** *New York Board of Fire Underwriters, Rochester, N. Y.*
**B. Z. SEGALL,** *Consulting Electrical Engineer, New Orleans, La.*
**R. E. WARD,** *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

## Sealing Conduits—Hazardous Locations

**Q.** *I have had many discussions and have received many opinions on the subject of sealing in hazardous locations. The greatest difference of opinion centers on the one word used in Section 501-5 concerning sealing, (practicable).*

*The sketches show the difference in our thinking. Would you please give us your views about this rule.*
*—J.M.K.*

**A.** For the convenience of our readers, the provisions of Section 501-5(a)-1 are:

"Seals shall be located as follows; In each conduit run entering an enclosure for switches, circuit-breakers, fuses, relays, resistors or other apparatus which may produce arcs, sparks or high temperatures, seals shall be placed as close as practicable and in no case more than 18 in. from such enclosures."

To me, the phrase "as close as practicable" means just what it says and permits the installer to place the seal any distance up to 18 in. away from the enclosure if practical requirements dictate any distance greater than that obtained by a close nipple. The word "practicable" includes requirements for installation, economics, and other factors such as accessibility for maintenance.

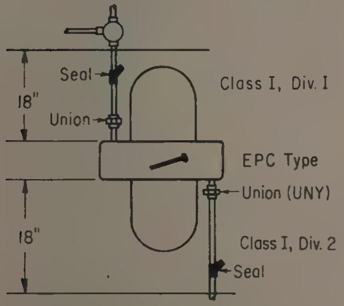
This opinion appears to be reflected by the fine print note under Section 501-5 A-2:

"Where two or more enclosures for seals as required under paragraphs 501-5(a-1, 2) are connected by nipples—not more than 36 in. long, a single seal—would be sufficient if located not more than 18 in. from either enclosure."

This explanatory note indicates that as a matter of economy and convenience, the conduit run between the enclosure and the seal may be any length up to 18 in. It also indicates, under such circumstances, that the question of practicability is satisfied. Similar conditions apply in such installations as parallel runs of conduit entering a lighting panel. It is frequently necessary to stagger the seals so that there will be space to rotate them during installation. Vertical seals vary in length from 3¼ in. to 12 in. depending upon conduit size, so it becomes apparent that in many instances, it is necessary to use a substantial portion of the 18 in. just to produce a practical assembly.

As shown by your diagrams, a union is installed between the enclosure and the seal. One might be inclined to observe that "if it is practicable to install unions at the points shown, it appears to be practicable to install seal fittings at such points." In other words, reverse the position of the seal and the union. This concept of the rule, however, may be questioned on the basis of practical considerations. If we think of two large enclosures connected by a run of conduit 36 in. long, as described in the above fine print note, it becomes apparent that we need a seal, but we may also need at least one union so we can get the assembly together. This union will be between the seal and one of the enclosures. There are many other examples which illustrate conditions where it would be practically impossible to use rigid conduit if the code did not permit a union between the seal and enclosure. Of course, any union in this location must be explosion-proof because it has to have the same explosion-proof integrity as the enclosure that is sealed.

TYPICAL INSTALLATIONS FOR AREAS AS SHOWN

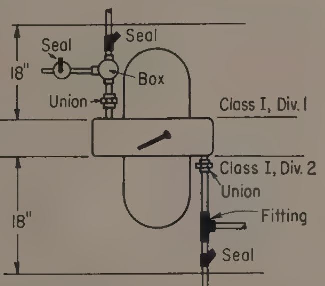


Sec. 501-5(a)-1. Sealing. Seals shall be placed as close as practicable and in no case more than 18 inches from such enclosures.

This is as the Inspection Department sees the installation.

*Editorial Comment. Transfer location of Seals and Unions.

Fig.1



Sec. 501-5(a)-1

The interpretation of this word (practicable) in this section of the code means convenient, fitted, agreeable, etc.

This is the system that we disagree with.

*See Editorial Comment.

Fig. 2

As shown by Fig. 2, we have a T fitting and a union between the seal and the enclosure, all of which are located in a Class 1, Div. 2 location. Since the T fitting may not be explosion-proof, it is probable that an explosion within the large enclosure would rupture the fitting, causing flame to be emitted. In this case the seal must be located between the T fitting and the enclosure. This is specifically covered by the second sentence of Section 501-5(b-1) which says "all portions of the conduit run or nipple between the seal and such enclosure shall conform to Paragraph 501-4(a). In other words, all boxes, fittings and joints within the conduit area described must be explosion-proof. In the upper left hand section of Fig. 2 a tee box is shown, and since it is located in a Class I, Div. 1 location, it is required to be explosion-proof. The use of the two seals shown appears to be superfluous, since the objective of sealing and code intent would be satisfied by one seal located on either side of the union depending upon practical considerations.

Fig. 1, which shows the explosion-proof unions located between the seals and the enclosures meets code requirements, but a greater degree of safety would be obtained by reversing the position of the seals and the union. This observation is based on the fact that an explosion-proof union will permit flammable vapors to enter the en-

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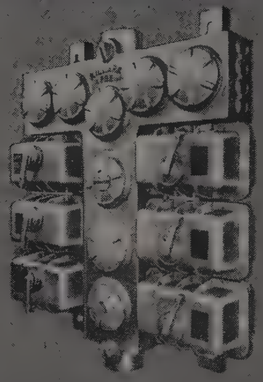

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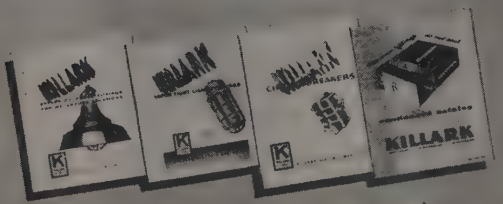

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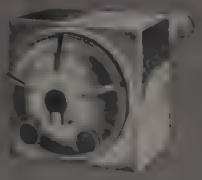

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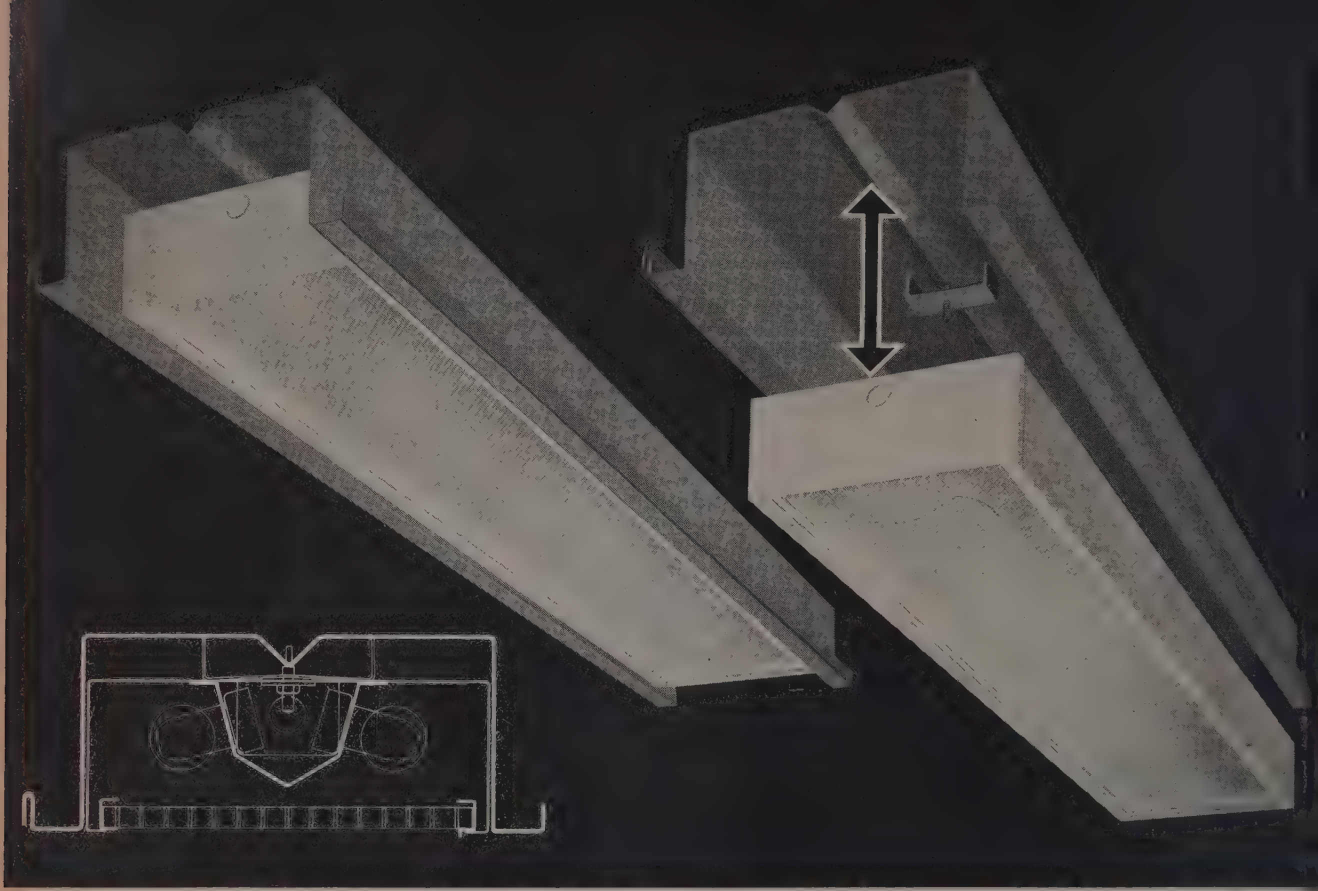
- Switch Racks
- Unions
- Vapor Proof Fixtures



*Here you see how easily new LPI troffers fit into flutes of Robertson Q-Deck. These rugged, die-formed steel fixtures are UL-listed with CBM-certified rapid-start ballasts, and are available in six stock diffuser types. Cross section shows simplicity of unit and convenience of installation. Troffers are wired complete, ready to go in.*

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closure, and in the event of an interior explosion the outside vapors will not be ignited, provided the union is properly installed and maintained. From the standpoint of safety, it is better engineering to avoid placing a union between a seal and the enclosure wherever practical because we thus avoid one more joint which might be improperly assembled during installation. If a union is not properly tightened, flame could emit through the joint. It also follows that Sections 501-5 (a-1) and (a-2) do not prohibit placing a union between a seal and the enclosure because it is recognized that there are practical requirements for a union in this location on some installations. There are several rules in the NEC contingent on factors of "practical consideration." The many variables and unusual circumstances involved with field installations demand a degree of code flexibility whereby the authority enforcing the code may apply a rule in accord with existing conditions. This appears to be the occasion involved with Section 501-5(a-1).—B.A.McD.—7/60/1

## Capacity Requirements

*Q.* *Under Article* 520, 1959 *National Electrical Code, Section* 520-4, *Exception No.* 2, *I note the capacity requirements have been changed from the* 1956 *National Electrical Code, Section* 5211, *from* 100 *to* 200 *persons.*

*Is the* 200 *figure a misprint or has the standard for wiring such occupancies been lowered?—A.E.*

*A.* The printing is correct in the 1959 National Electrical Code as the change has been made in order that requirements in the National Electrical Code will be the same as other recognized publications. You will note printed under Exception No. 2 the fine print note referring to the National Fire Protection Association Building Exits Code No. 101 which can be used in determining population requirements of occupancies. Although the number has been increased from 100 to 200 capacity, I hesitate to say the standard has been lowered in view of having a definite guide referred to to determine population capacity. Heretofore electrical inspectors were at a loss as to a recognized method of determining the population capacity.—R.E.W.—7/60/2

## Trailer Parks

Our Canadian friends are quite interested in our code problems. The following comments refer to Question 2/60/4:

"Mr. Segall's answer to the question concerning service conductor size for a 5-unit trailer court states that there is no specific provision for trailers and trailer courts in the NEC, and after calculating the demand load, he concludes that three No. 2 RH is too small, the calculated demand being 136 amps, requiring three No. 2/0 R or No. 1/0 RH.

"Whether or not it is your policy to publish comments or portions thereof which arise from these questions and answers, perhaps it would be of interest to Mr. Segall and the others who write this section to know that the subject of trailers and trailer courts is covered in the Canadian Electrical Code. Due to the close liaison across the border on code matters, there may be at least a 50-50 chance that this particular subject will be handled in a very similar fashion in the next edition of the NEC.

"Under one set of conditions the original service feeder would be the correct size. Calculation is as follows:

"See rules R67-008, r-052(1), 4-050(1), 4-068(1)(a).

"If the premises are actually operated as a public trailer court, a receptacle must be provided for each trailer space (R67-004). The type of trailer described requires a 50-amp receptacle. Some courts standardize on 60-amp.

"Demand is based on the capacity of the receptacle, and is 65% for the first two, 25% for the next 18, 10% for the rest. For the case in question:

"50a *Receptacles*

$$2 \times 50 \times .65 = 65$$
$$3 \times 50 \times .25 = 37.5$$
$$\overline{\phantom{00}}$$
102.5-amp

3 No. 1 R or TW
or 3 No. 2 RH or THW

"60a *Receptacles*

$$2 \times 60 \times .65 = 78$$
$$3 \times 60 \times .25 = 45.5$$
$$\overline{\phantom{00}}$$
123.5-amp

3 No. 1/0 R or TW
or 3 No. 1 RH or THW

"Rule 4-048(1) provides that where the next smaller wire size is not more than 5% under the calculated demand, that size may be used at the discretion of the inspection authority. In jurisdictions where permission for this is cus-

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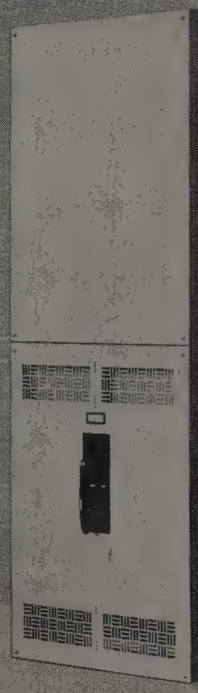

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Height—90⅜ inches
Width—34 and 38 inches
Depth—15, 25 and 29 inches

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DB-type air circuit breakers
up to 2000 amperes
Pressure-type fusible
switches up to 2000 amperes
AB-type circuit breakers
up to 800 amperes
Space for current
transformers and meters

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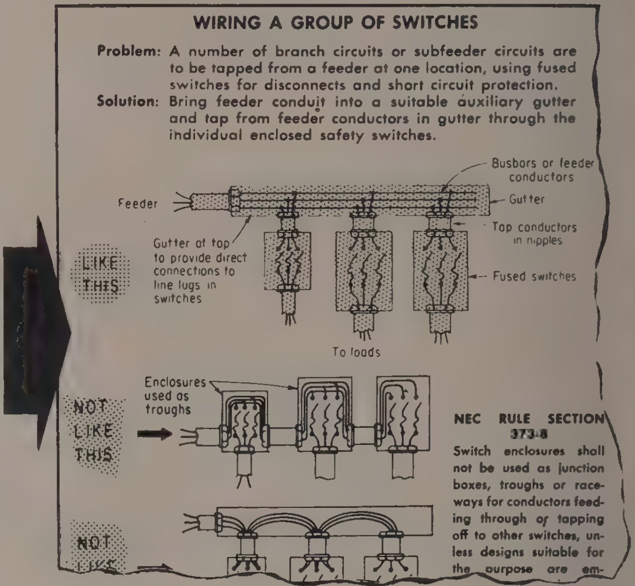

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**Problem:** A number of branch circuits or subfeeder circuits are to be tapped from a feeder at one location, using fused switches for disconnects and short circuit protection.

**Solution:** Bring feeder conduit into a suitable auxiliary gutter and tap from feeder conductors in gutter through the individual enclosed safety switches.

**NEC RULE SECTION 373-8**

Switch enclosures shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless designs suitable for the purpose are em-

Busbars or feeder conductors
Feeder
Gutter
Top conductors in nipples
LIKE THIS
Gutter at top to provide direct connections to line lugs in switches
Fused switches
To loads
Enclosures used as troughs
NOT LIKE THIS
NOT LIKE

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## CONTENTS

General Considerations
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(273-076)

tomarily automatic, the service for the 50-amp receptacles may be reduced to

3 No. 2 R or TW

or 3 No. 3 RH or THW (No. 3 is not commonly stocked by suppliers).

"The similarity between the NEC and the CEC is most convenient, and in cases where the NEC covers an item not found or not sufficiently detailed in the CEC, or in provincial or local counterparts or supplements, it is common practice for the inspection authorities to refer to the NEC for guidance. Perhaps this tactic would be handy in reverse at times, as the CEC also has many items not found in the NEC.

"Current issue of the CEC Part I is the 7th edition ($1.50) with supplement "R" (25¢), and is obtainable from Canadian Standards Association, 235 Montreal Rd., Ottawa 2, Ont.—R.J.W."—B.Z.S.—7/60/3

## Conductors

**Q.** *On a residence using a telescope type service extending above the roof of the building, it is a requirement that the conduit riser be at least 2 in. for mechanical strength in order that service wires from the service pole to the conduit may be supported without bending the conduit.*

*The conduit is of ample size to allow circuit conductors for an outside circuit in addition to the service wires that are to be placed in the conduit. Does the code permit such an installation.—H.M.*

**A.** No. Your question is answered in Section 230-43 which is as follows:

"Other Conductors in Service Raceway. Conductors other than service conductors, grounding conductors, or control conductors from time switches having overcurrent protection, shall not be installed in the same service raceway or service entrance cable."—R.E.W.—7/60/4

## UF Cable

**Q.** *What depth does the code require a UF cable to be buried where the cable supplies a yard light on residential property?—H.M.B.*

**A.** There is no specific depth requirement in the code.

Section 310-6 refers to Type UF cable as being suitable for direct burial in the ground. This section also provides for supplementary mechanical protection, but in no way specifies the depth of burial of the cables.

Article 339 deals entirely with Type UF cables, but it does not have any definite requirements as to the depth of installation of the cables. This Article also repeats the requirements for supplementary mechanical protection.

The supplementary mechanical protection may be required by the local code enforcing authority WHEN HE CONSIDERS SUCH PROTECTION IS NECESSARY. Thus, if in the opinion of this local code authority it is necessary to further protect the buried UF cables, he may require these cables to be installed in a conduit, or he may require that a covering board, such as a 2-in. thick piece of pecky cypress, be placed directly above the buried cables, or that a concrete pad be similarly installed.

The inspector has to use his own judgment as to where he may require this supplementary protection. In other words, the conditions of installation are too varied so that it is impossible to set up definite depths. In one case, because of the particular conditions of a specific installation, the buried cables may be perfectly safe and secure from further physical damage even though they may be located only 6-in. below grade and they would not require any additional mechanical protection. In another installation, the conditions may be such that the inspector may require the supplementary mechanical protection because he feels that even placing the cables at a depth of 2 ft will not protect them from further physical abuse.—B.Z.S.—7/60/5

## Wiring 240-KW Oven

**Q.** *We are contemplating the installation and wiring of an electric oven, which will have 200 1200-watt elements, to be operated on 240 volts, 3-phase current.*

*We propose to operate the oven with one section being wired for constant heat, and the other section to have controlled heat. The setup now is to use two main switches at the service entrance, and run proper size feeders to a control switchboard consisting of two banks of six switches. One group of six switches will handle the constant heat and the other group of six switches will handle the controlled heat. The question has come*

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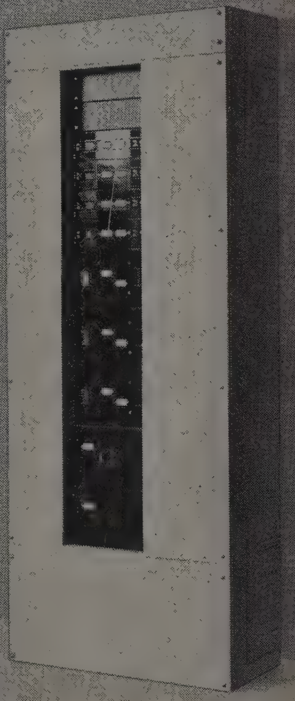

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For applications up to 600 v a-c, 250 v d-c
Height—90⅜ inches
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*up with the inspection department as to whether or not there should be a main switch at the control panelboard, which is 46 ft distant from the main switchboard. Also the question has been discussed as to the necessity of holding the branch-circuit feeder wire to one-third the size of the main feeder. As a basis for their arguments they call attention to the NEC, Sections 430-4 and 430-58. Since these sections pertain to motor circuits, I contend they have no bearing on the installation which we propose, because this is strictly a heating circuit and there is very little specific information in the code regarding such an installation. Can you give me some further information in regards to this problem? A sketch of the proposed installation is shown below (Fig. 1).—W.E.J.*

***A.*** An appliance is defined as follows: "Appliances are current-consuming equipment, fixed or portable; for example, heating, cooking and small motor-operated equipment."

In the case under question, we have an electric oven rated at 240 kw, and it appears that the code rules covering appliances in Article 422, apply. Your first question concerns code requirements for the disconnecting means. Since the oven is a stationary appliance, it appears that the provision of Section 422-16(b) applies. This Section is quoted as follows;

"For stationary appliances of greater rating (300-volt amps or ⅛ hp) the branch-circuit switch or circuit breaker may, where readily accessible to the user of the appliance, serve as the disconnecting means."

A literal reading of this rule indicates to me that only one branch circuit switch or CB was visualized when the rule was formulated. As a result, it would be difficult to interpret this rule so that the 12 disconnecting switches on the control panelboard would be recognized as the disconnecting means for this rather large oven.

The general provisions for an appliance disconnecting means are expressed under Section 422-14:

"Each appliance shall be provided with (a) means for disconnection from all ungrounded conductors." Here again, the use of the word (a) indicates one disconnecting means. It is significant to note, however, that the provisions of Section 422-16 merely require the disconnect to be "readily accessible." As in the case of motors and controllers, as covered by Section 430-4, the disconnect is not required to be visible and not more than 50 ft distant from the oven, unless it is a motor-driven appliance. As in the case of an electric sign, the disconnect is not required to be within sight of the sign (Section 600-2a). As a result, it appears that there is a distinction in hazard between these various applications of a disconnecting means. If motors are involved with the installation, it appears from your diagram that they are served from circuits independent of

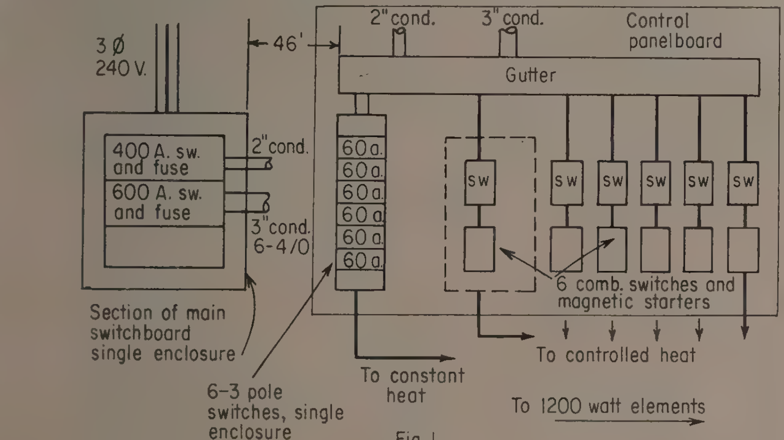


Fig. 1

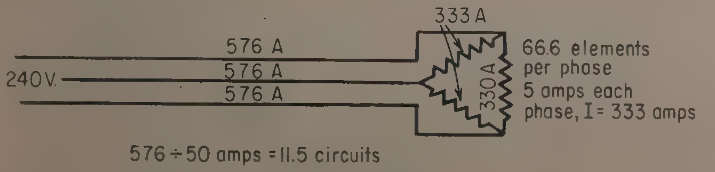
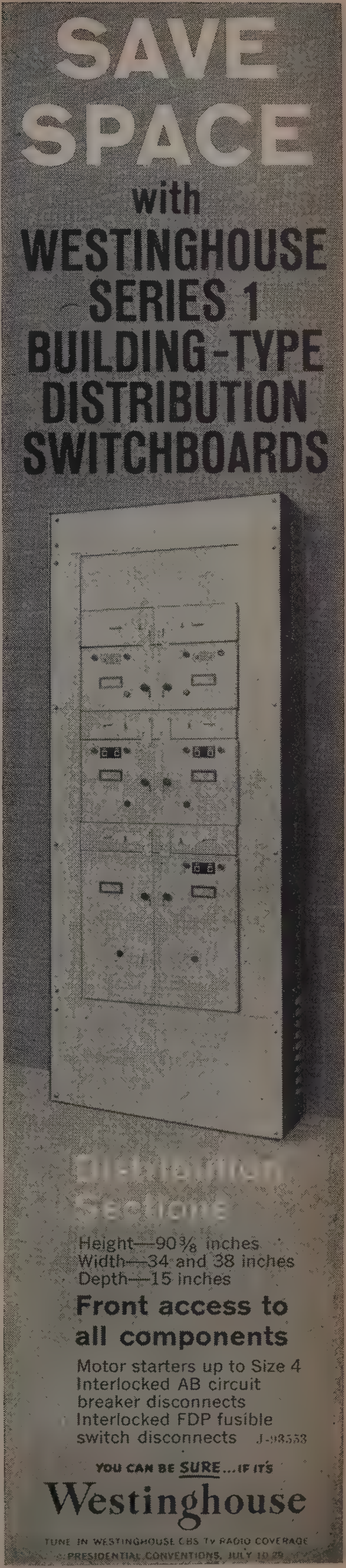

333 A
576 A
576 A
576 A
240 V.
330 A
66.6 elements per phase
5 amps each phase, I = 333 amps
576 ÷ 50 amps = 11.5 circuits

Fig. 2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Depth—15 inches

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Motor starters up to Size 4
Interlocked AB circuit breaker disconnects
Interlocked FDP fusible switch disconnects J-93553

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the heat control panel and another problem enters the picture. The question of what constitutes a "motor-driven appliance" is not covered by the code. Therefore, some authorities have interpreted this phrase to cover appliances where the major portion of the load is a motor load. It would be questionable, in my opinion, to classify a 2000-watt heater with a 1/20 hp fan as a motor-driven appliance.

Since the code does not specifically cover the oven application in question, I would be inclined to apply the principles outlined in Section 422-11 covering infrared lamp industrial heating appliances. Reference to this rule indicates that "each section, panel or strip carrying a number of infrared lampholders (including the internal wiring of such section, panel or strip) is considered an appliance. The terminal connection block to each such assembly is deemed an individual outlet."

If each section, panel or strip is considered to be an appliance, it appears that the provisions of Section 422-16 would be satisfied if a disconnecting means for each appliance was installed. Applying the same logic to the oven in question, it appears that the 12 disconnects as shown on the control panel, supplemented by the two feeder switches less than 50 ft away would adequately satisfy the requirements for a disconnecting means. It would, in my opinion, be more adequate than that now required for a service disconnecting means.

Reference to the Proposed Amendments to the 1951 NEC indicates the need for the code to cover in detail the installation of heating loads. The International Association of Electrical Inspectors submitted a proposal for a new Article 490 covering rules for resistance heating equipment. It was rejected by Panel No. 10. Since that time rules covering the installation of fixed electrical space heating have been inserted in Article 422, but the status of large ovens with respect to present code rules, should in my opinion, be more clearly covered in the code.

In reply to your second question, am I correct in assuming that the 12 60-amp switches located on the control panelboard are not fused switches? If such is the case there is a code violation. The provisions of Section 422-20(a) require an appliance to be protected against overcurrent by one of the circuits specified in Article 210. The provisions of Section 422-20(b) require a range or similar appliance with a maximum demand of more than 70 amps to have the main circuit subdivided into two or more circuits, each provided with overcurrent protection rated at not more than 50 amps. Section 422-20(c) limits the overcurrent protection for infrared lamp heating appliances to 50 amps. To be consistent, it appears to me that the 200 1200-watt elements should be connected to 50-amp branch circuits as described in Section 210-24(c). The number of circuits and the number of heating units connected to each circuit would depend upon the nature of operation and the demand required. Assuming that the circuits are 3-wire, 3-phase, the units would be connected in delta over the phases. As a result, three 1200-watt units connected in delta over the phases at 240 volts would have a phase current of 5 amps and a line current of 1.73 times 5 which is approximately 8.7 amps. This factor also enters the picture when computing the number of circuits required on the basis of 50 amps per circuit. Fig. 2 illustrates this factor. If some of the circuits are loaded for long periods of time, as covered by Section 210-23(b) such circuits are subject to the 80% derating factor. This may be compensated by the demand load on other circuits. If the 60-amp switches are not fused, there is in my opinion a code violation. If they are fused, there appears to be no occasion to discuss the provisions of Section 430-58.—B.A.McD.—7/60/6

## Aluminum Conduit—Comment

As a result of the question relative to the installation of all like phases of conductors in the same conduit (Question 2/60/1) there has been some comment which I believe is quite pertinent. I received the following test data and comment from one reader:

A test procedure was set up using two 10-ft lengths of 3½-in. rigid aluminum conduit. The two conduits were set parallel to each other and spaced 1 ft apart. Four Type RH, 500 MCM copper conductors were connected in parallel and energized from a single phase source. The total load on the conductors was 1500 amps, 60 cycles.

The following results and comments are taken verbatim from the reports of this test:

"The induced voltage over each 10-ft length of conduit approximated 0.625 volts. The magnitude of this induced voltage is, of course, a factor of both the length of the conduit and the amount of current in the conductor. With one end of the conduit grounded in accordance with National Electrical Code requirements, no shock hazard exists; however, serious hazards do exist from the currents which can be made to flow as a result of this relatively low voltage.

"With one end of the conduits tied together and grounded as they would normally be in service, the accidental grounding or bridging of the conduits with metal at any point along their length results in a splashing arc which could cause serious results in any hazardous location. This arc or the current through the bridging member could cause serious burns to the hands when making contact or even ignite combustible materials.

"If a sufficiently low resistance path is provided between the ends of the conduit, a relatively high current (a current approaching the value of the current in the conductor) will flow in the conduits. This current in combination with the conduit resistance produces an $I^2R$ loss which results in the heating of the conduit to a point which can be in excess of that permissible for most insulations. Inadequate conductivity at the grounded ends can result in even more watts loss and additional heating. Besides heating, the watts loss in the conduit can be detrimental to both customer and utility, to the customer in the form of reduced service voltage, and to the utility in the form of loss in revenue because the service entrance conduit is normally on the line side of the meter."—B.Z.S.—7/60/7

## Non-Metallic Sheathed Cable Protection

**Q.** *Section* 3366 (336-8) *of the NEC covers the use of non-metallic sheathed cable in unfinished basements. It reads as follows:*

*"If the cable is run at angles with joists in unfinished basements, assemblies not smaller than two No.* 6 *or three No.* 8 *conductors may be secured directly to the lower edges of the joists; smaller assemblies shall either be run through bored holes in the joists or on running boards. Where run parallel to joists, cable of any size shall be secured to the sides or face of the joists."*

*Does this ruling apply to the crawl space under a house?—J.H.D.*

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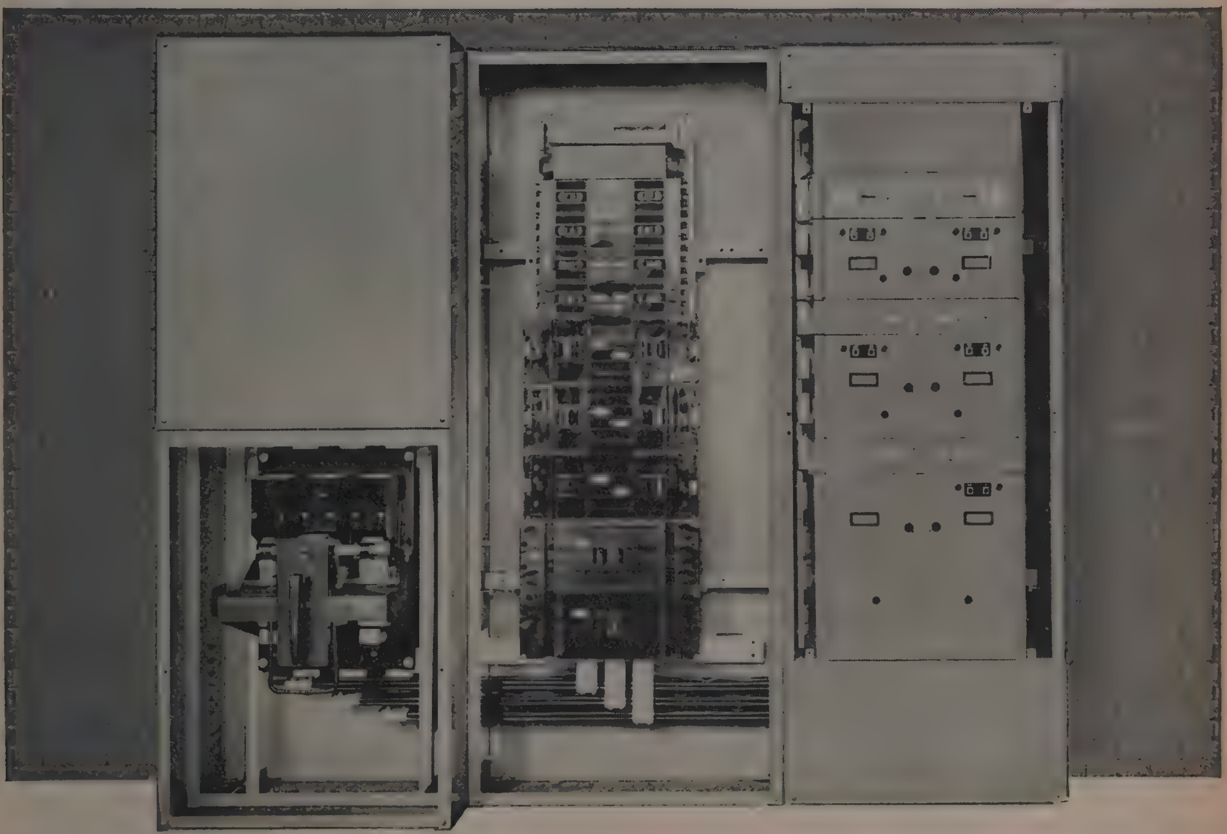

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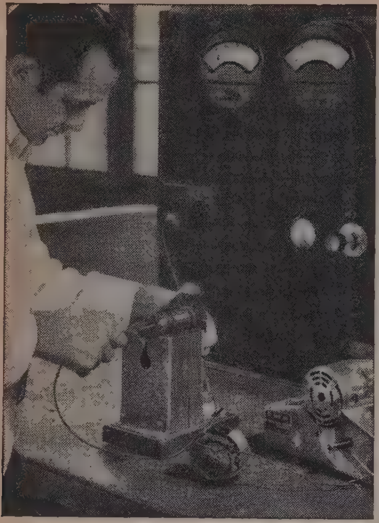

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*A.* In the absence of any code distinction between a basement of a house, and a crawl space under the house, the authority enforcing the code has the responsibility for interpreting this rule. Regardless of his opinion in this matter, it appears that the provisions of Section 3364 (336-6), covering exposed work would apply. We also have another general rule found under Section 300-4 which requires conductors to be adequately protected from mechanical injury. A crawl space under a house usually ends up as a storage space for miscellaneous articles or tools. It usually is accessible so that plumbers and other mechanics, who have little concern with the wiring system, may maintain or repair their systems. I, personally, believe it is a location where the cable could be exposed to mechanical injury, and I believe the provisions of Section 336-6 or 336-8 should be enforced.

Official Interpretation No. 300, issued 11/7/47, touches on this question as follows:

"Question: Who is to determine what protection if any, from mechanical injury is needed when applying paragraph b of Section 3364 of the 1947 edition of the National Electrical Code?

"Finding: The authority enforcing the code."

In the case in question I would require the cable to be protected as covered by Section 336-8. When the intent of code rules are questionable, it appears to me that we should not gamble with a possible hazard.—B.A.McD. 7/60/8

## Wiring Dust Ignition-Proof Fixtures

*Q. Where does the code cover "dust tight fixtures" installed in a Class 2, Division 1, location? The fixtures I am referring to operate with an inside temperature of 90 C. How long must the leads be from the branch-circuit conductors to the fixture? This factor is covered by the code for recessed fixtures. Should it likewise be considered for "dust tight fixtures"?—H.B.*

*A.* Section 502-11 (a) of the 1959 Code covers the type of fixture required to be used in a Class 2, Division I location. They are described as follows;

"Each fixture shall be dust-ignition-proof and approved for Class 2 locations, and clearly marked to indicate the maximum wattage of the lamp for which it is approved."

Such fixtures are designed to be mounted direct to an outlet box, or as pendant fixtures as covered by Section 502-11 (a3). Since the question raised does not appear to be covered under Section 502-11, the general rules of the code apply as covered by Section 502-1. As a result Article 410 covering Lighting Fixtures applies. Section 410-17 tells us that "Fixture Conductors shall be so arranged that they will not be subjected to temperatures above those for which they are approved."

Section 410-19 (a) tells us that "fixtures shall be wired with conductors having insulation suitable for the current, voltage and temperature to which the conductors will be subjected."

Section 410-19 (d) refers us to Section 310-2 for the maximum operating temperature and voltage limitation of fixture wires.

Section 410-20 specifically covers the type of fixture wire to use for certain conditions, such as fixtures provided with or without mogul base screw-shell lampholders operating at not more than 300 volts between conductors. Table 310-2 (a) covers the maximum operating temperature of both fixture wires, and the branch circuit conductors to which they are connected.

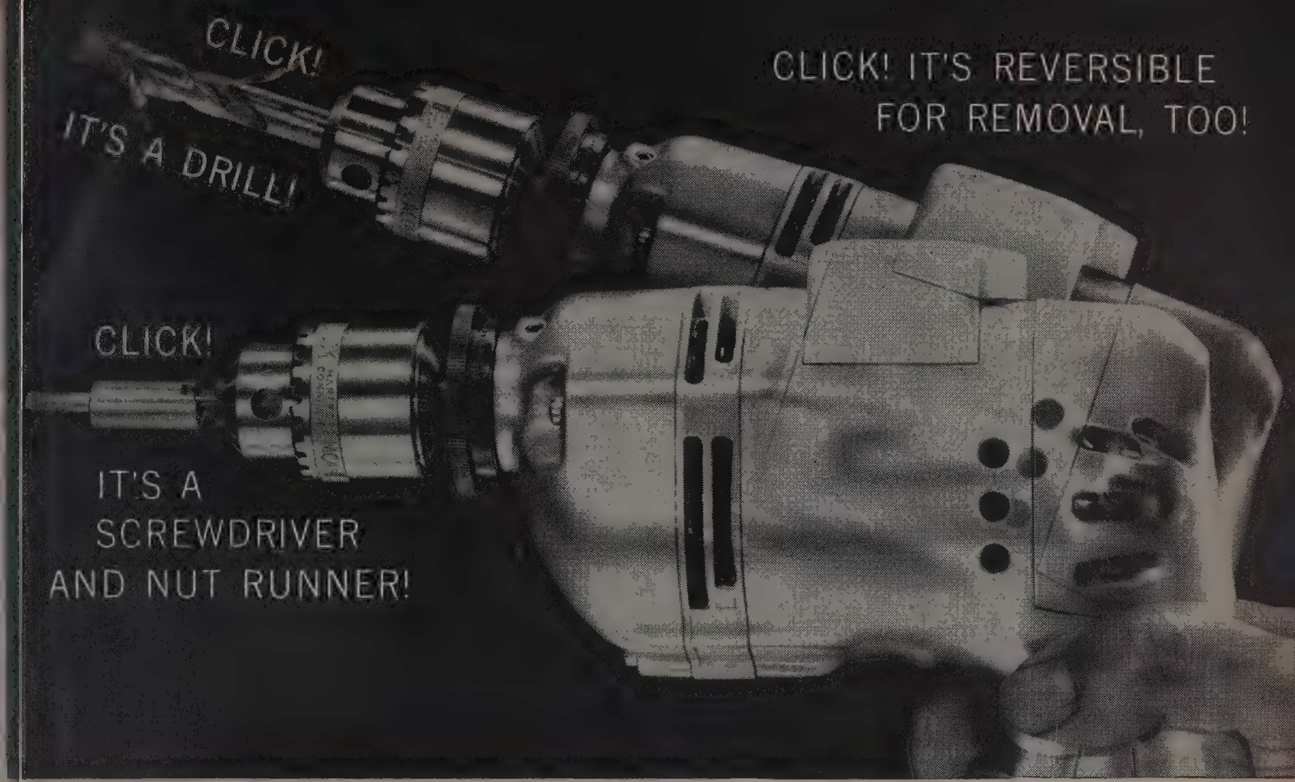
It is significant to note that the foregoing rules do not cover the length of the fixture leads from the fixture terminals to the outlet box to which they are connected. In the case of flush and recessed fixtures which have terminal connections operating at temperatures higher than 60C (140F), Section 410-65 (b2) requires a 4- to 6-ft tap from an outlet located at least 1 ft from the fixture. This rule does not apply to the dust-ignition-proof fixtures in question. Such fixtures could be attached direct to the outlet box provided the conductors were suitable for the temperature involved. Reference to Underwriters' listing covering fixtures for use in a Class 2, Division 1 location indicates that the question of conductor insulation is clarified by notes reading as follows:

"Asbestos covered wire should be used when making connections."

"Asbestos covered wire should be used when making connections unless otherwise noted."

"Insulation of supply conductors should be suitable for 60C."

"Wire used for connections should have insulation suitable for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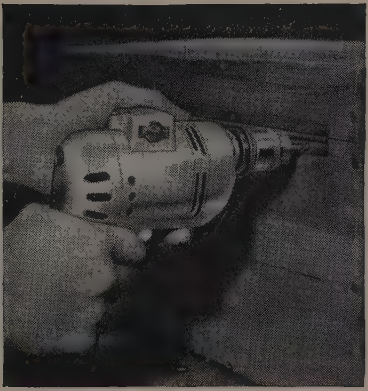

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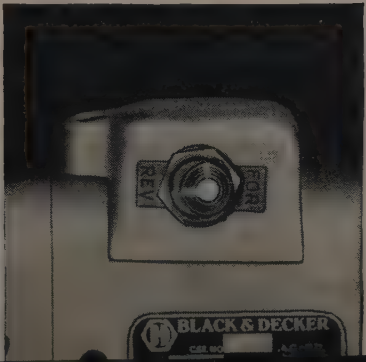

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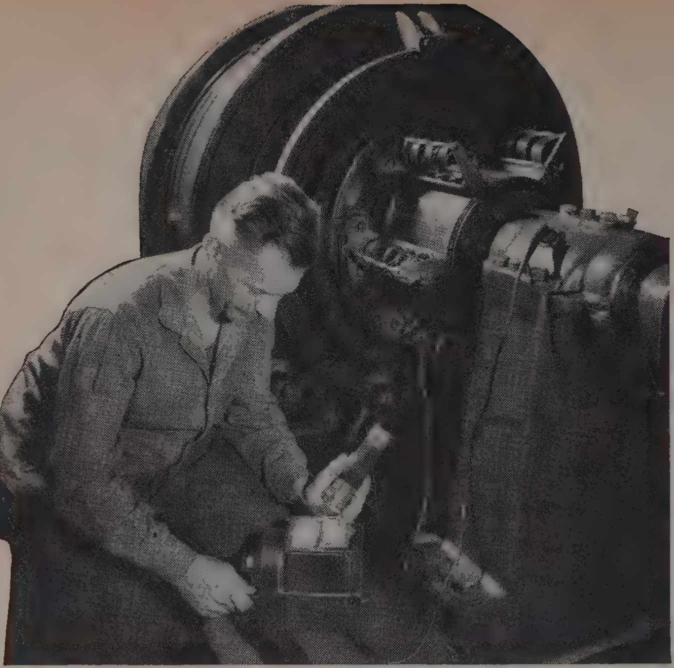

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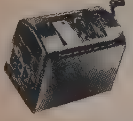

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75C for 75- and 100-watt sizes, 90C for 150- and 200-watt sizes, and 150C for 300- and 500-watt sizes."

"Insulation for supply conductors should be suitable for 75C."

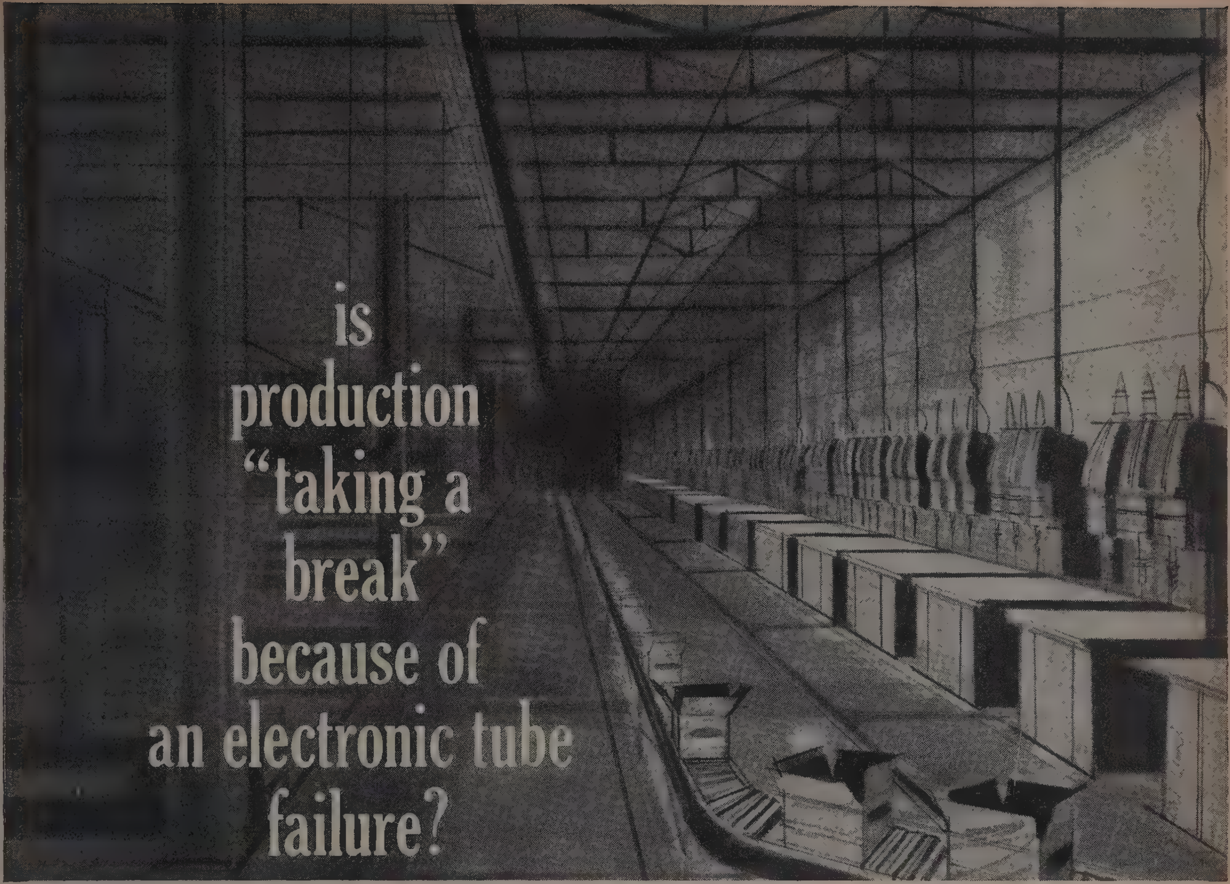
In view of the foregoing, I suggest that you consult pages 18-21 of the UL listing of fixtures labelled for use in hazardous locations. Check the manufacturer's catalog number against any advice given by UL. If there is no advice and you know that the temperature within the fixture enclosure is 90C, a 90C insulation should be used for wiring the fixture. The type of insulation of the branch circuit conductors would depend upon the installation. If the fixture was mounted direct to the outlet, it appears that the branch-circuit conductors would be subject to a 90C temperature. If the fixture is attached as a pendant remote from the outlet, it is possible that a 60C conductor could serve as the branch-circuit conductor. In the absence of authoritative advice from UL or the manufacturer, it appears that a local test is in order. This was the procedure followed by some authorities in the early days of the recessed fixture.—B.A.McD.—7/60/9

## Range Components Branch Circuits Demand

Q. *A question has come up lately on the new code rules governing surface top ranges. Will you please give us your opinion on this matter? Would a 7.5 kw range top be rated according to the name plate, or would Column B of Table 220-5 apply? If so, No. 10 wire would be adequate.*

*I maintain that paragraph (i) under Section 220-4 says that even though a surface top unit is less than 8 kw specified in Column A, it be considered as an 8 kw unit in figuring the feeder and the 80% demand factor be applied to that load which would give us a 6.4 kw demand load. Note 4 of Article 220-5 says that in lieu of the above mentioned method of figuring, the nameplate rating be used with Columns B or C. Note 5 of the same section also says to use the table.*

*Now, the second sentence of Note 5 seems to be the puzzler. Does that second sentence explain what a branch circuit load as specified in the first half of the sentence consists of, or does it contradict itself and maintain that the nameplate rating shall be considered at 100%.*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| 610 | 500 | 0.4 | 0.1 |
| 624 | 2500 | 80.0 | 6.4 |
| 627 | 5000 | 2.5 | 0.64 |
| 628 | 2500 | 8.0 | 2.0 |
| 629 | 350 | 0.2 | 0.04 |
| 632B | 1500 | 30.0 | 2.5 |
| 672A | 2500 | 40.0 | 3.2 |
| 676 | 2500 | 40.0 | 6.4 |
| 677 | 10000 | 15.0 | 4.0 |
| 678 | 15000 | 6.0 | 1.6 |
| 884 | 350 | 0.3 | 0.075 |
| 885 | 350 | 0.3 | 0.075 |
| 2050 | 1300 | 1.0 | 0.1 |
| 5557 | 5000 | 2.0 | 0.5 |
| 5559 | 1000 | 15.0 | 2.5 |
| 5560 | 1000 | 15.0 | 2.5 |
| 5685 | 1250 | 77.0 | 6.4 |
| 5796 | 1500 | 20.0 | 1.6 |
| 6011 | 1250 | 30.0 | 2.5 |

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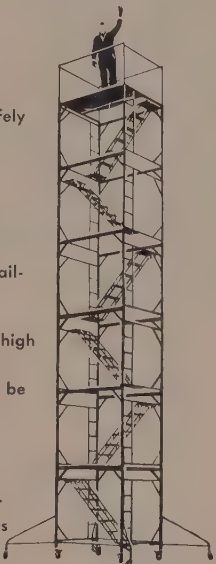

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*If so, No. 10 would be too small and we would have to use No. 8. Your opinion in this matter would clarify quite a discussion.—C.W.*

**A.** A 7.5 kw counter-mounted cooking unit has a full load current rating of 32.6 amps at 230 volts which requires a minimum No. 8 conductor. The demand factors covered by Column B do not apply since they are only concerned with cooking appliances rated at less than 3.5 kw. I believe that you intended to refer to Column C, Paragraph (i) of Section 220-4 which concerns the feeder load for household electric ranges and other cooking appliances rated more than 1.75 kw. As a result, it does not apply to one counter-mounted cooking unit served by an individual branch circuit. Note 5 following Table 220-5 applies to the application under discussion. It is quoted as follows:

"Branch Circuit Load. Branch circuit load for one range may be computed in accordance with Table 220-5. The branch circuit load for one wall-mounted oven or one counter-mounted cooking unit shall be the nameplate rating of the appliance."

It is significant to note the distinction between a range and a range component. In the case of a range, demand factors are applicable since the various units which comprise the assembly are not likely to operate at full load simultaneously. In the case of the counter-mounted cooking unit the demand may be 100%, and the last sentence of the above quoted rule anticipated such operation. I do not believe that Note 5 is contradictory. The first sentence concerns ranges with several cooking units, and the second sentence concerns an individual cooking unit. In view of the foregoing concept of code rules, the 7.5 kw unit under discussion must be served by No. 8 conductors.—B.A.McD.—7/60/10

## Service Entrance Cable Use

**Q.** *Article 338 of the National Electrical Code covers the use of SE cable. In your opinion, is the use of SE cable with an uninsulated neutral, when used as a sub-feeder within a building from a main distribution section to a sub-panel, a violation of the code?—D.F.*

**A.** The provisions of Section 338-3 of the N.E. Code covers the conditions under which a service-entrance cable, without individual insulation on the grounded conductor, may be used as a feeder or a branch circuit. While such use includes a feeder from a service cabinet to supply other buildings, the rule does not recognize the use of such cables for feeders or sub-feeders to a sub-panel within the building. Such procedure would be a direct violation of Section 338-3 of the code.

About 12 years ago this question was discussed at considerable length on the basis of the inconsistency which appears to prevail. In fact, a proposal for such use was rejected by the Electrical Committee.—B.A.McD.—7/60/11

## FHP Motor

**Q.** *The following items describe an installation:*

1. *Wall-mounted fixed fan unit.*
2. *Controlled by switch within sight of motor.*
3. *UL approved assembly.*
4. *Motor rated 1/10 hp*
5. *Installed on 15-amp circuit.*

*Does the Code Section 430-32b require overload protection?—R.B.B.*

**A.** Yes. The last sentence of Paragraph 430-32b is applicable to this problem. This requires protection in accordance with paragraph 430-32c when the fractional horsepower motor (the Code terminology is actually 1 horsepower or less) is permanently installed.

This (c) paragraph lists four methods for providing motor running overcurrent (overload) protection.—B.Z.S.—7/60/12

## Aluminum Conduit

**Q.** *There is a question in my mind with respect to the use of aluminum conduit. Has the NEC Board any power to enforce the proper usage of this pipe? On a big job that I am working on at the present time, all the pipe is aluminum of all sizes up to 4 in. It is laid in the gravel grading with a 4-in. slab of concrete on top. This is the finish floor. We know this aluminum conduit can be used in some places when it is painted inside and out.—R.C.M.*

**A.** It is a matter of record that aluminum rigid conduit has been listed by UL, as a nonferrous

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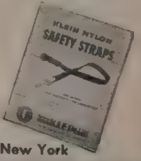

WRITE FOR BULLETIN 560

ASK YOUR SUPPLIER
Foreign Distributor:
International Standard Electric Corp., New York

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
INCORPORATED
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metallic conduit as far back as 1932. Up until the past couple of years, general acceptance by the wiring industry has been deterred due to the economic considerations involved. At the present time, it is considered to be competitive in price with other conduits.

Section 346-1 of the NEC covers the use of rigid metal conduit. Advice received from UL during the past year indicates that aluminum conduit could be used in all places where galvanized steel conduit was suitable so it would not appear appropriate to restrict the use of untreated aluminum conduit. As a result, the provisions of Article 346 apply equally to steel or aluminum conduits, where UL is concerned.

A reliable report covering aluminum calls our attention to the many variables involved when conduits are directly buried in the ground. Galvanic action, oxygen concentration cells, and stray currents. In order to protect aluminum from such destructive influences, it is suggested that it be protected by an inert organic coating such as an asphalt base paint. The report further advises that such protective coatings should be applied to steel as well as aluminum conduits.

In the case of uncoated aluminum, the case history of a field installation indicates severe corrosion when such conduits are buried in concrete having a heavy concentration of calcium chloride admixture due to the excessive galvanic corrosion between the reinforced steel and the aluminum conduit.

An approved protective coating might have eliminated this corrosive effect. Calcium chloride has been used during winter weather as an accelerator and densifier admixture for concrete, and it is contended that steel and other metals as well as aluminum are subject to corrosion when exposed to this admixture. There are other accelerating admixtures for cold weather which contain little, if any, calcium chloride, and they should be specified if we wish to avoid the destructive corrosive influences which the case history verifies.

At the present time, the code does not specifically cover such factors as admixtures and protective coatings, and it is difficult to formulate such rules without the assistance of a fact-finding report from UL. I do believe however that such questions will eventually be specifically covered by the code. In the meantime, the authority enforcing the code has the responsibility for interpreting the provisions of Section 346-1, as it applies to aluminum or steel conduits.—B.A.McD. —7/60/13

## NEC Amendment

### RECOGNITION OF 601-800 AND 801-1200 FUSE CLASSIFICATIONS NEC TENTATIVE INTERIM AMENDMENT NO. 113 (Effective April 22, 1960)

Tentative Interim Amendment No. 113 to the 1959 edition of the National Electrical Code has been released by the National Electrical Code Committee of the National Fire Protection Association. Developed under the published Procedure for Tentative Interim Amendments, it is recommended by the Committee for application in the administration of the 1959 NEC.

Effective April 22, 1960, the amendment concerns recognition of two classifications of fuses, 601-800 and 801-1200, instead of the one 601-1200 classification now given in the code. It is also included in the proposal submitted by NEC Code-making Panel No. 4 in connection with preparation of the proposed 1962 National Electrical Code.

The following is the official text of the Tentative Interim Amendment No. 113.

The text of Section 240-23 (a) as revised now reads:

*240-23. Cartridge Fuses and Fuseholders.* Cartridge fuses and fuseholders shall conform to the following:

(*a*) *Classification.*

(1) 0-600 amp cartridge fuses and fuseholders shall be classified as regards current and voltage as follows:

| Not over 250 volts Amperes | Not over 600 volts Amperes |
|---|---|
| 0- 30 | 0- 30 |
| 31- 60 | 31- 60 |
| 61-100 | 61-100 |
| 101-200 | 101-200 |
| 201-400 | 201-400 |
| 401-600 | 401-600 |

(2) 601-6000-amp cartridge fuses and fuseholders shall be classified at 600 volts as follows:

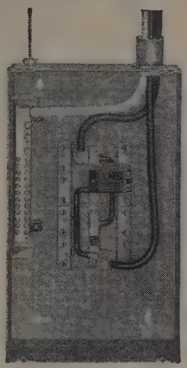
601- 800 amps
801-1200
1201-1600
1601-2000
2001-3000
3001-4000
4001-6000

There are no 250-volt ratings over 600 amps, but 600-volt fuses may be used for lower voltages. Subparagraphs 240-23 (b) and (c) remain unchanged.

## *It's a main disconnect... It's a subfeed...*

Cat. No. TRP1212

Plug in new TQAL breaker in usual manner on load centers rated 125-200 amps, then *backfeed* by connecting line conductors to breaker terminals. TQAL now acts as main disconnect for entire service; current to remaining breaker positions cannot exceed rating of TQAL.



Cat. No. TRP1220

Plug in new 70-amp TQAL breaker on devices rated 125-200 amps; new 100-amp TQAL on devices rated 200 amp, then connect subfeed load conductors to breaker terminals. The TQAL is now a "SUBFEED MAIN" for separate branch controlling heat pump, heat panel, etc.

# It's General Electric's new TQAL circuit breaker!

*70 and 100 amps, 2 poles, 120/240 volts a.c. U/L listed*

## *Just plug it in and save the cost of separate main disconnect enclosures*

Two new plug-in circuit breakers now add even greater versatility to the General Electric "TWIN"* load center line. Both are designed on the same one-inch modulus as all G-E plug-in breakers, so you can plug them in *anywhere* on the bus ("TWIN" load centers are sequence-phased). Both poles trip automatically when a fault occurs on either one.

In G-E load centers rated 125 amperes and above, these new TQAL breakers will bring you real savings wherever main disconnects are required. Write for Bulletin GEA-7071.

**Trademark*

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LIVE BETTER ELECTRICALLY

PROTECTING MEDALLION HOMES
EQUIPPED BY GENERAL ELECTRIC

**GENERAL ELECTRIC**

**Circuit Protective Devices Dept., Plainville, Conn.**

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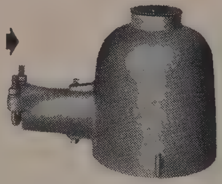
**BACKED BY ALMOST**

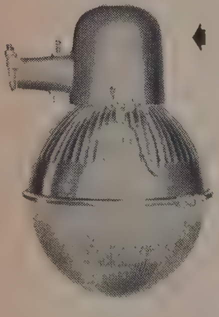
**80 YEARS EXPERIENCE**

## STREET & HIGHWAY LIGHTING

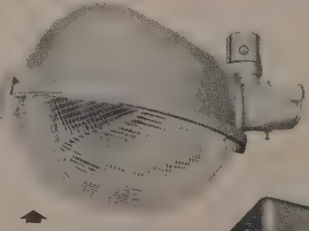
One-piece NEMA standard side entrance or top entrance aluminum head with transformer or choke coil—for 100, 175 or 250 watt mercury lamp. Illustrated is side entrance head with NEMA standard twist lock adapter and Fisher-Pierce 6600A Photo-Control. For use with Class "A" and "B" reflectors. Request information on conversion kit for existing NEMA standard incandescent heads.



One-piece NEMA standard aluminum head with NEMA standard twist lock adapter for Photo-control. Also available with 1¼" plug. Junior style heads with NEMA standard twist lock adapter are also included in the Pemco line.



Style 80 Standard Enclosed Luminaire for series or multiple circuits. IES Types I, II, III, IV and V. Hinged or wedge band. Fluted alzak reflector. Also available with Style 20 Top Entrance Head. For incandescent or mercury lamps, with or without adapter for Photo-control (see above). There is a variety of Pemco Open Reflectors to fit both Standard and Junior Heads.



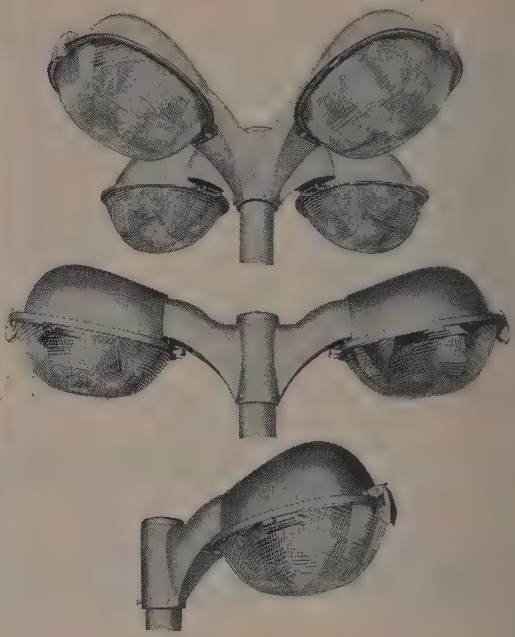
Three styles of Pemco Mercury Luminaires, with or without NEMA Standard twist lock adapter:

Style 67 for 250 watt Mercury Lamp—IES Types II and III.

Style 68 for 400 watt Mercury Lamp—IES Types II, III and IV.

Style 69 (with built-in ballast) for 400 watt Mercury Lamp—IES Types II, III and IV.

## AREA LIGHTING



Pemco 4-Lite All aluminum Mercury Area Luminaire for high level illumination using four 400 watt mercury lamps, and matching 1-Lite and 2-Lite Luminaires. Highly efficient —unusually attractive.

Other Pemco Area Luminaires include 36", 48", 60" and 72" dia. aluminum reflectors with ball globe for one 500 to 1500 watt incandescent or 400 to 1000 watt mercury lamp . . . Fluorescent Area Luminaires . . . Walkway and Shrubbery Luminaires . . . Incandescent and Mercury Floodlights.

When requesting literature and catalogs be sure to specify on what type outdoor lighting.

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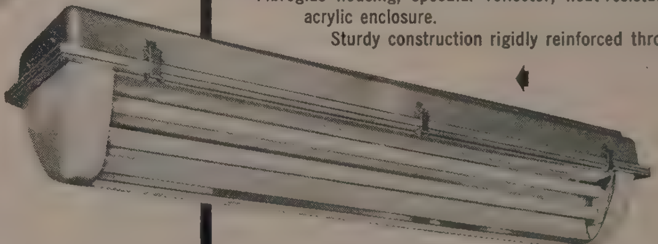
Pemco Metropolitan Fluorescent Luminaires—
Style 48 for 2 or 4—48" 800MA or 1500MA lamps.
Style 72 for 2 or 4—72" 800MA or 1500MA lamps.
Fibreglas housing, specular reflector, heat-resistant clear acrylic enclosure.
Sturdy construction rigidly reinforced throughout.



## Chicago E.E.A. Honors Founders

Five founders and senior members of the Chicago Electrical Estimators Association were honored with life memberships at the May meeting of the 42-year-old organization. Each received a handsome framed certificate "as an expression of the high personal esteem and regard in which he is held by our members and in recognition of the valuable service he has rendered in this association."

Receiving the coveted honor were the following who have contributed so much to the refinement and standardization of electrical estimating procedure:

Arthur C. McWilliams—retired head of McWilliams Electric Co.; one of the founders and ten-time president of CEEA; major contributor to the development of the unit pricing system; an inventor with some 65 patents in the electrical field; a tireless investigator of electrical construction problems.

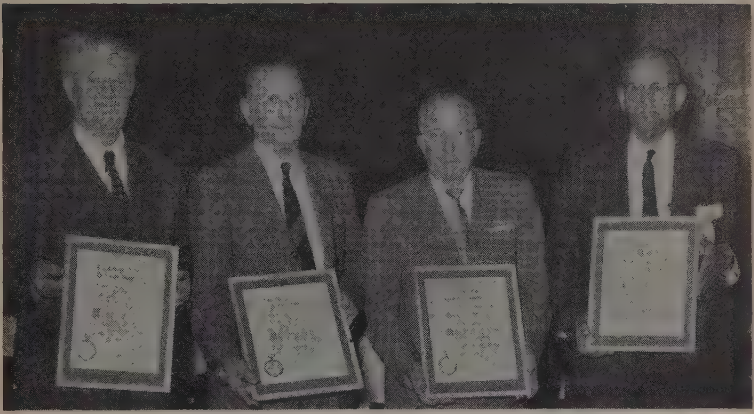
Albert R. Locke—retired; founder of CEEA in 1918; developer of panelboard labor units and originator of "the lug rule" for estimating panelboard connection time.

Axel G. Soderberg—Fries-Walters Electric Co.; charter member and twice president of CEEA; dedicated contributor to the work of the labor-unit group; active member of the electrical fraternity since 1910.

Rudolph A. Morrison—retired; former principal of Pierce Electric Co.; charter member of CEEA and one of the original developers of the first labor-unit manual presented at the 1918 NECA convention in Cleveland.

Ray Ashley—research and consulting engineer; consulting editor, *Electrical Construction & Maintenance;* past-president of CEEA; nationally recognized authority on estimating; author of the book *Electrical Estimating,* and numerous published articles on the subject.

The more-than-70 members of the Chicago Electrical Estimators Association are justly proud of the historical contribution their organization has made in the development and standardization of systematic electrical estimating procedures and job-cost analyses. Among other things, CEEA has been credited with: origination of the now-standard labor-unit system of estimating; development of the first labor-unit manual; promotion of more accurate cost-data records; and, in general, raising the status of electrical estimating from the chaotic levels of the early 1900's to the present status of a well-organized, systematic procedure designed to increase accuracy and reduce estimating time. Improving methods is a universal topic at all meetings. In fact, CEEA's two most active committees reportedly are those concerned with man-hour cost data and the code with its relation to design and installation techniques.



**ESTIMATING PIONEERS** and founders of the Chicago Electrical Estimators Association are honored with life memberships in CEEA. They are: (L to R) Albert R. Locke, Oak Park, Ill.; Ray Ashley, Oak Park, Ill.; Rudolph A. Morrison, Chicago; and Axel G. Soderberg, Chicago. Another certificate recipient, Arthur C. McWilliams, Evanston, Ill., was unable to attend the presentation.

## NFPA Announces 1962 NEC Timetable

A December 1, 1960 deadline for receipt from the public of any proposed changes in the current 1959 National Electrical Code has been announced by the National Fire Prevention Association. Such proposed revisions will be considered in the preparation of the 1962 edition of the code which will be submitted for approval at the NFPA annual meeting in May 1962.

Development of the new code follows definite procedural steps which include study and review of all proposed changes by the code-making panels, electrical inspectors, the electrical industry and others. Copies of the proposed changes should be filed with code-making panel chairman as well as with Merwin Brandon, chairman, and Frank Stetka, secretary, of the Electrical Correlating Committee. Names of these key personnel are listed in the 1959 edition of the *NEC,* copies of which are available (at $1.00 each) from NFPA, 60 Batterymarch Street, Boston 10, Mass.

The following is the procedural timetable for the 1962 Code:

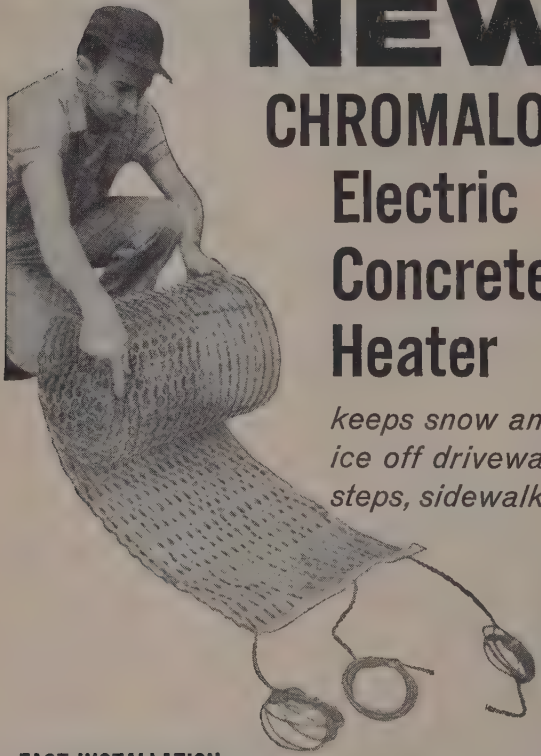
Dec. 1, 1960—Final date for receipt of proposals for revisions from the public.

Jan. 1—April 15, 1961—Code-making panels considering proposals for Code changes and preparing reports.

Apr. 15, 1961—Panel reports made to Correlating Committee.

May 15, 1961—Informal report to Electrical Section by Correlating

**NEW OFFICERS** of the Chicago Electrical Estimators Association are: (L to R) secretary—Stanley C. Wielgos, Premier Electrical Construction Co.; president—William G. Steele, Kelso-Burnett Electric Co.; vice president—G. D. Garrison, Divane Bros. Electric Co.; treasurer—William A. Sieck, Block Electric Company. Albert R. Locke is custodian.



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CHROMALOX
Electric
Concrete
Heater

*keeps snow and ice off driveways, steps, sidewalks*

**FAST INSTALLATION.** Just unroll heater mat in form just before pouring 1½″ top layer of concrete. Insulated heater wire is interwoven in 10′ x 18″ or 6′ x 18″ galvanized wire mesh. Mats may be connected end-to-end or side-by-side.

**POSITIVE PROTECTION.** Turned on when snowfall or freezing begins, mats prevent accumulation, keep protected areas clear of snow and ice without shoveling, salt or cinders. Excellent sales feature for new homes. 42 watts per sq. ft. Two 10′ leads and 10′ ground wire attached. UL listed.

**ECONOMICAL.** List $24.95 for 10′ length DTW 26, $21.95 for 6′ length FTW24 . . . typical operating cost about 7½ cents an hour for 2 tracks of 30 foot driveway.

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Electric Heat
INDUSTRIAL · COMMERCIAL · RESIDENTIAL
EDWIN L. WIEGAND COMPANY
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**FINAL CHECK** of conference agenda at Milwaukee meeting of Wisconsin inspectors is made by chief electrical inspectors R. J. Ridley, Janesville, and C. N. Sinnott, Kenosha, prior to final session.

Committee at NFPA Annual Meeting.

July 1, 1961—Panel reports published for distribution to Electrical Section members and others interested.

July 1—Dec. 1, 1961—Period for study by electrical inspectors, industry and others, and recommendations to panel chairmen for changes.

Feb. 15, 1962—Panels make final report to Correlating Committee.

March 15, 1962—Correlating Committee submits proposed changes to NFPA for printing and distribution.

May 14, 1962—Review by Electrical Section and action by NFPA Annual Meeting. Submission by NFPA to American Standards Association for approval as American Standard.

Sept., 1962—Publication of new code.

**CODE HUDDLE** finds: (L to R) F. E. Volkman, chief electrical inspector, Appleton, Wis.; M. C. Hutzel, Bliss Electric Service, Brodhead, Wis.; and chief electrical inspector Robert Johnson of Wauwatosa, Wis., discussing field problems at recent Wisconsin Chapter, IAEI convention in Milwaukee.

# SPECIAL REPORT ON

# PTC TRANSFORMERS

Showing WHY Electrical Engineers, Consulting Engineers and Contractors should Seriously Consider Specifying and/or Installing them on ANY Job.

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**EVERY PRECISION TRANSFORMER IN THE ENTIRE LINE OFFERS THESE BASIC CONSTRUCTION ADVANTAGES:**

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***3. RIGID CORE CLAMPING***—Core laminations are clamped together with structural steel; not formed sheet steel.

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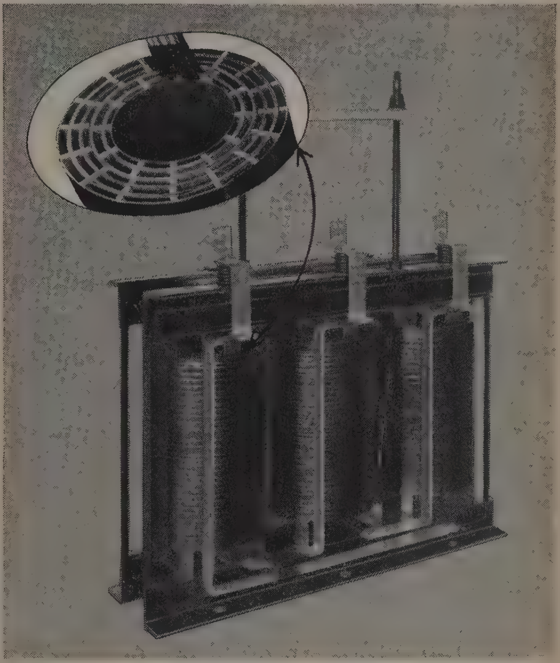

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***1. EXTREME QUIETNESS***—

| KVA Transformer Rating | Present NEMA | Precision Average Sound Level Standard Design | Special Design |
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| 9–30 | 50 | 40 | 34 |
| 37½–112½ | 55 | 42 | 38 |
| 125–167 | 60 | 44 | 42 |
| 200–300 | 62 | 48 | 46 |

***2. EFFICIENCY***— Precision Transformers have the lowest operating loss of any transformer.

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***5. LOWER INSTALLATION COSTS***—All PTC Transformers provide neater installations at lower cost.

***6. TOTAL WARRANTY***— Unconditionally guaranteed by Precision Transformer Corp. for 5 years.

## COMPLETE LINE

Whatever your transformer needs, there is a dependable, quiet, long-lasting PTC dry or liquid type transformer—more than 4,000 models ranging from ¼ to 5,000 KVA.

Included is the whisper-quiet, inside-the-wall "HUSH-FLUSH" design for schools, libraries, hospitals, churches, theatres, etc.

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ALUMINUM WITH ALZAK FINISH. STEEL PORCELAIN ENAMELED. FOR 300-1500 WATT INCANDESCENT OR MERCURY VAPOR 400-1000 WATT NARROW BEAM—MEDIUM OR WIDE SPREAD. THREDLOK SOCKETS.

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INCANDESCENT DUAL LIGHT GIVES MORE LIGHT WHERE NEEDED. CAST ALUMINUM. VENTILATED FOR COOLER OPERATION. HAS CONVENIENCE RECEPTACLE ON SIDE.

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ALUMINUM WITH ALZAK FINISH. HINGED HEAT & IMPACT RESISTING LENS. FOR INCANDESCENT OR MERCURY LAMPS. ALSO PORCELAIN ENAMELED STEEL ANGLE, OPEN, ELLIPTICAL & ENCLOSED TYPES.

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500 WATT FOR PARKING AREAS. PORCELAIN ENAMELED ALL WHITE REFLECTOR.
COMPLETE LINE OF PAR LAMPHOLDERS, SPLICE BOXES, FITTINGS, COLORED LENS & ACCESSORIES.

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**CEILING DRUM TYPE FIXTURES**
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4 & 8 FOOT RAPID START, SLIM LINE, HO & VHO POWER GROOVE.

YEAR AFTER YEAR FOR 35 YEARS AND MORE THE SAME UNBROKEN CHAIN OF OWNERSHIP WITH THE SAME AIMS AND STANDARDS QUALITY MATERIAL CUSTOMER SATISFACTION HAVE MADE MULTI PREFERRED BY
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**NEW CHAIRMAN** of the Wisconsin Chapter, IAEI, A. W. Bahr (left) receives congratulations from retiring chairman Thomas Hosni, Jr., at Milwaukee meeting. Mr. Bahr is the chief electrical inspector of the City of Madison, Wis.

## Bahr Heads Wisconsin Inspectors

A. W. Bahr, chief electrical inspector of Madison, Wis., was named chairman of the Wisconsin Chapter, International Association of Electrical Inspectors at its 35th Annual Meeting in Milwaukee May 12-13. Other officers elected to serve with him are: vice-chairman—Arve Amundson, Cashton, Wis.; secretary-treasurer—John E. Wise, Madison. F. E. Volkman, Appleton, and S. J. Mazlack, West Allis, are members of the executive board.

The two-day meeting had a highly educational flavor. At the sessions, inspectors learned more about: fire alarm systems; inherent protection of 3-phase motors; non-interchangeable circuit breakers; raceway fill; high-frequency bus duct; latest improvements in cable insulations. The usual code discussion sessions provided answers to many inspector field problems.

Inspectors indicated considerable interest in a demonstration and ex-

**SKULL SESSION** between chief electrical inspectors L. D. Knapp, Franklin, Wis., and W. N Martin, Cudahy, Wis., pursues subject of mechanical protection for direct-burial cables of Wisconsin Chapter, IAEI convention in Milwaukee.

1

# SPECIFY CLIFTON CONDUIT

## The conduit with built-in quality

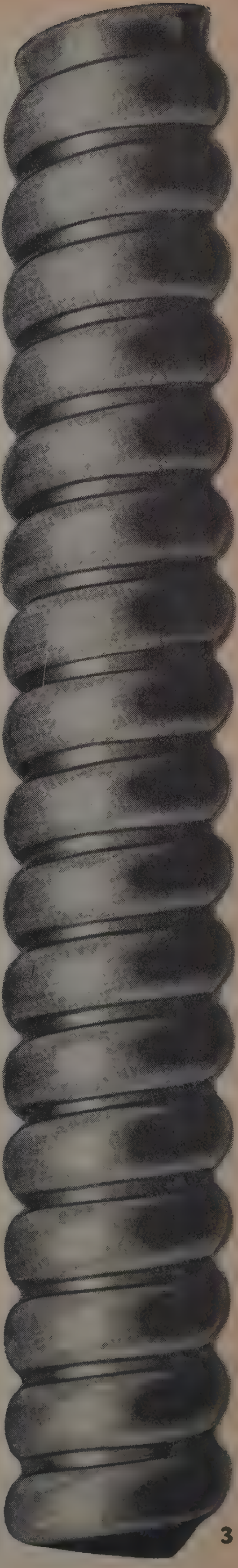
**1** **EMT** (Electrical Metallic Tubing) the only hot-dipped galvanized tubing—inside and out for complete protection •flat, clean, continuous weld for smooth interior surface and ease of pulling during installation.

**2** **RIGID CONDUIT** made of the finest steel available • Clifton's exclusive process for hot-dipped galvanizing guarantees a uniform zinc protective coating ...inside and out • the finest rigid conduit made. Clifton Rigid Conduit is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WW-C581C and ASA Specification C-80.1-1953. Clifton EMT is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WW-T-806B and ASA Specification C-80.3-1953. RIGID CONDUIT ELBOWS, COUPLINGS, AND NIPPLES in a full range of sizes • are manufactured of the same fine high quality steel as RIGID CONDUIT • hot dipped galvanized inside and out.

**3** **FLEXIBLE STEEL CONDUIT** really flexible and crush-resistant for easier and faster installations • manufactured under Clifton's rigid controls from purchase of high quality steel tape to finished product • smooth inside surface assures you trouble free pulling during installation. Clifton Flexible Steel Conduit is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WWC-556. Other quality products by Clifton: Bushed Armored Cable; Unarmored Service Entrance Cable; (CLIFTX) Non-Metallic Sheathed Cable; CLIFTALL-UF; Building Wire —TW, RHW, RR.

**CLIFTON CONDUIT CORPORATION**
A Division of General Cable Corporation
3300 Eastbourne Ave., Baltimore 24, Md.

2


3

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**SEND** for free sample of "SCOTCH" BRAND Electrical Tape No. 23. A high-voltage (to 15 kv) splicing tape that's instant fusing and easy to use. Eliminates the need for heated splice rollers, cement, and critical elongation requirements. Retains excellent corona resistance over emergency overload and short-circuit loading-temperature ratings. For high-voltage rubber, plastic, and synthetic cables.

**SEND FOR FREE TEST KIT!** Write on your letterhead to 3M Co., 900 Bush Ave., St. Paul 6, Minn. Dept. EAA-70.

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN. EXPORT: 99 PARK AVENUE, NEW YORK 16. CANADA: LONDON, ONTARIO.

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW
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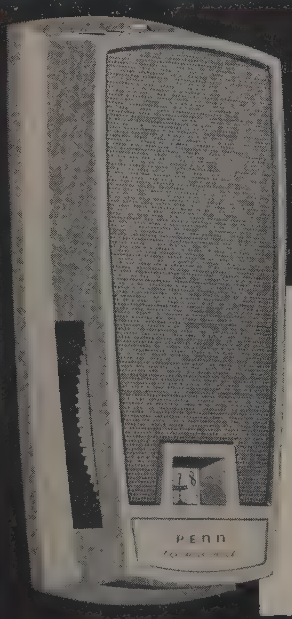

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NEW IDEA
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There's no other room thermostat like it. Its large dial actually "meters" desired temperature changes. Each "click" is a change of 1° . . . reduces tendency to over-, or under-adjust. And, it gives faster response to both convective and radiant heat. You'll also like the faster installation and easier wiring. Write for Bulletin 3205 . . . it's free!

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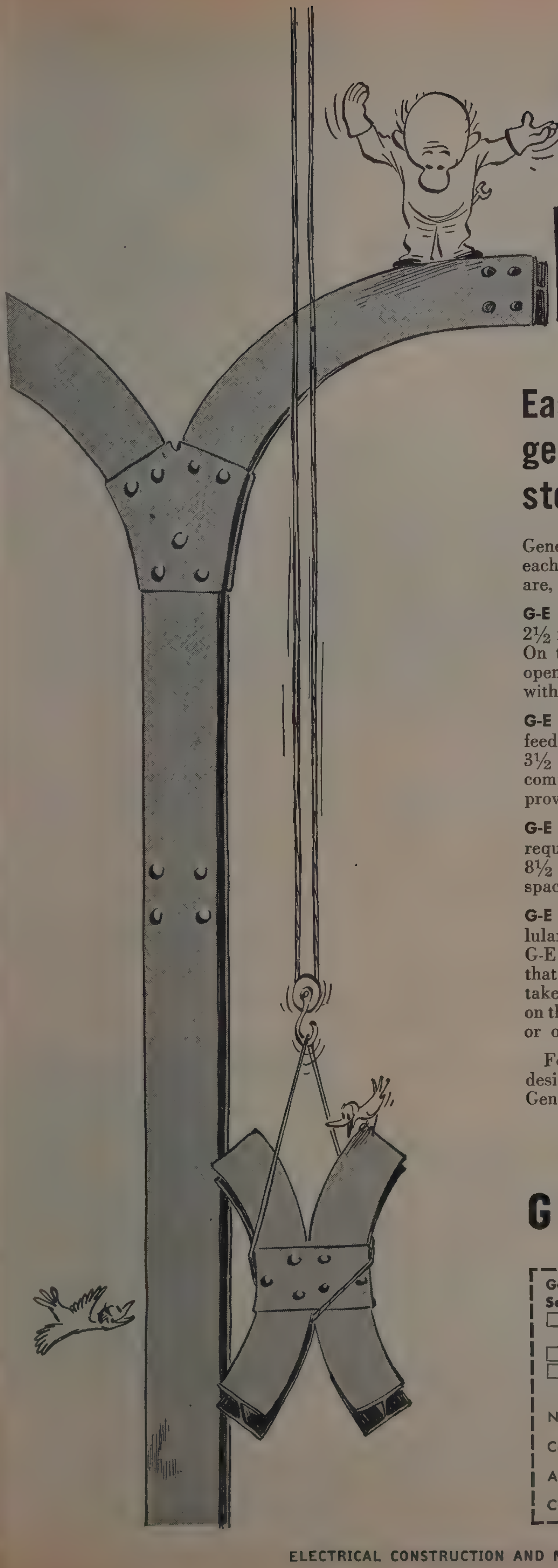
EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.
AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

**RETIREMENT GIFT,** a movie camera, is presented to John E. Wise (right) by code consultant Grover E. Kruecke at the 35th Annual Meeting of the Wisconsin Chapter, IAEI in Milwaukee. Mr. Wise retired this June as electrical engineer of the Industrial Commission of Wisconsin in Madison. He is a past international president, IAEI; past president of the Western Section, IAEI; past chairman and present secretary-treasurer of the Wisconsin Chapter, IAEI.

planation of high-frequency plug-in busway with transposed phase configuration. With a frequency range of 180 to 20,000 cycles and low voltage-drop characteristics (less than one volt per 100 ft at 400 cycles), this duct provides an economical means of distributing high-frequency power for induction heating, polishing and grinding and numerous other applications, noted Charles Volk, Westinghouse Electric Corp., Beaver, Pa. If voltage drop can be effectively controlled, frequencies up to 30,000 cycles will be prevalent in the future, he predicted.

The nearest thing to a universal conductor insulation is now on the market with all manufacturers licensed to produce it, revealed R. S. Ochsner, Milwaukee district repre-

**W. O. ZERVAS,** research engineer, American Iron & Steel Institute, New York, updates Wisconsin electrical inspectors on developments in steel raceways and the latest code derating factors for more than three conductors in a raceway.



# EASY DOES IT!

## Easy installation is something you get with all four General Electric steel underfloor wiring systems.

General Electric makes all four underfloor wiring systems — and each of General Electric's four systems is easy to install. Here they are, and some of the features that make them so easy to work with.

**G-E Standard System** can be installed in poured concrete floors 2½ inches thick. Inside cross-sectional area is 3.357 square inches. On triple duct systems, all systems can be fed through conduit openings in the corners of the boxes. Junction boxes can be leveled without removing covers.

**G-E Two-level System,** for complex feeding problems, normally feeds through lower level, distributes through upper level. Requires 3½ inches floor fill. In multi-system installations, each system is completely separate. Additional feeds for any system can be provided at any desired location.

**G-E BIG DUCT** gives lots of capacity in a simple, low-cost system requiring only 3 inches of floor fill. Interior cross-sectional area is 8½ square inches. Increased cross-sectional area gives more work space, makes wire pulling much easier.

**G-E Cellular-steel Floor Wiring System** installed in a structural cellular floor provides maximum capacity with maximum flexibility. G-E header duct for cellular installations is available in lengths that make it easier to center junction units over floor cells, and to take up minor variations in cell spacing without cutting and fitting on this job. Junction unit interiors are completely free of any screws or other encumbrances thereby providing maximum work area.

For valuable manuals that contain complete installation, layout, design and product data, just fill in the coupon and mail it to General Electric.

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**General Electric Company, Conduit Products Department**
**Section CU94-718, Bridgeport 2, Connecticut**

☐ Please send me your bulletin on single- and two-level steel underfloor wiring systems.

☐ Please send me your bulletin on cellular-steel floor wiring.

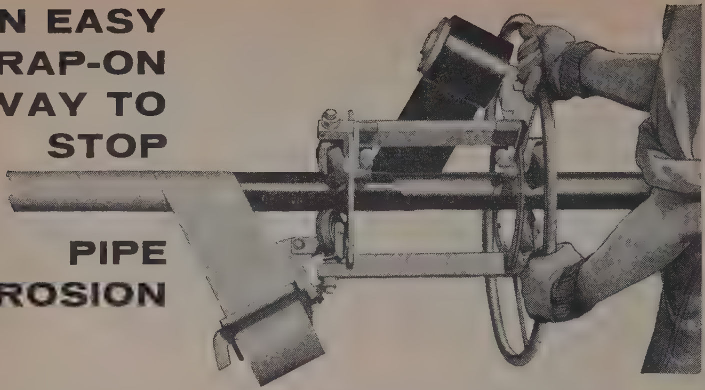
☐ Enclosed is a description of my underfloor wiring problem. What do you suggest?

Name________________ Title________________

Company________________

Address________________

City____________ Zone______ State__________



AN EASY WRAP-ON WAY TO STOP PIPE CORROSION

**CHASEKOTE*** Pressure-Sensitive Polyethylene Tape has an extra-heavy adhesive mass that clings to clean pipe on contact . . . makes a perfect, permanent bond that rustproofs, waterproofs and insulates pipe against all types of corrosion.

**CHASEWRAP*** Protective Overwrap is a tough, wrinkle-free outerwrap that shields against abrasion, wear, and physical damage to the tape. Wraps simultaneously with the tape. Superior to rag and felt wraps, yet far lower in cost.

**Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable.*

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**The new CORR-PREV Pipe Coating Team** comes in easy to handle tape form. It goes on pipe faster and lasts longer than corrosion-proof paints. It's cleaner and simpler to apply, too, than hot tar coats. And most important, this new CORR-PREV Team offers all the cost-cutting, pipe-saving advantages of polyethylene tape.

**With CHASEWRAP Abrasion-Resistant Overwrap** and Chasekote polyethylene tape, you get the easiest and best pipe protection at lowest applied cost! There's no heating, drying, clean-up or shut-down time. Each roll is factory-uniform in thickness and quality. And all coating materials — including rental of high-speed applicators — are available from one reliable source. Want samples? Specs? Prices? Write **CHASE & SONS, INC., 26 Spruce Street, North Quincy, Massachusetts.**

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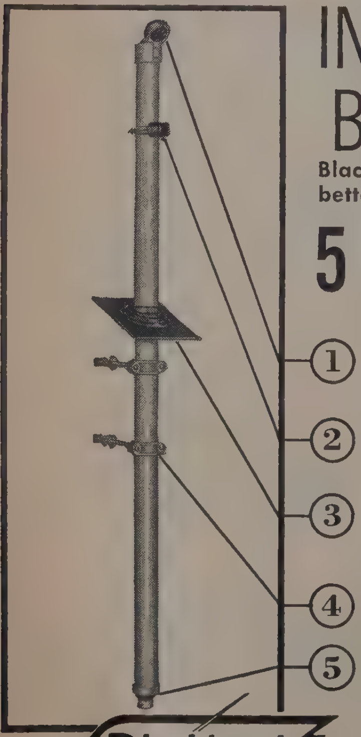

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**Blackhawk Service Entrance Mast Kits better from top to bottom**

5 GOOD REASONS *why a Blackhawk kit means a faster, better installation from cable entrance to meter. May be purchased as a complete kit or as separate fittings.*

1. **Slip-fitter service entrance head**—Just slip it on over conduit and tighten two set screws. That's all. Made of corrosion-resistant aluminum. Available in a full range of sizes.
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3. **Flexible Synroflashing** — Made of flexible neoprene to absorb vibration. Mast can't work loose, damage shingles, or cause leaks. Won't rot, peel or crack in any weather. Available for 1¼, 1½, 2, 2½ and 3" pipe.
4. **Mounting brackets**—New combination bracket accommodates 1¼, 1½, 2, 2½ and 3 inch pipe. Available with ½ inch thru bolts or with lag screws.
5. **Offset reducer** — Corrosion-resistant aluminum alloy. Fits 1¼" and 1½" hubs to a 2" or 2½" pipe riser and 2" hub to 3" pipe riser.

The better-made parts in a Blackhawk kit let you do a fast and sound job on every service entrance mast installation. Saves you time, builds your reputation for quality and service. **Specify B-I when you buy!**

Blackhawk Industries
DUBUQUE, IOWA *where the new ideas come from*

**EARLY ARRIVALS** at electrical contractor sessions of recent Upper Midwest Electrical Industry Convention in Minneapolis ~~included~~ Victor Zarich, Zarich Electric, ~~and~~ R. C. Edman, Kohler Electric, both of Hibbing, Minn.

sentative, General Electric Company. Known in G.E. as Vulkene (a thermosetting vulcanized compound), it combines the best electrical and mechanical properties of polyethylene and neoprene, he added. Immediate applications include triplex service drop conductors and aerial spacer cables. While presently limited to 600 volts and under, Ochsner sees the range extended to 5 kv next year and 169 kv by 1965. He also presented a detailed description of the relatively new varnished dacron-glass tape insulation which, because of its superior electrical and mechanical properties, could well replace varnished cambric in cable assemblies. Interlocked armor cables with VDG insulation and internal ground wires (equipment ground) are now being produced at the same cost as conventional VC interlocked armor cable without ground wires, he noted.

Other speakers covering the

**MEA DIRECTORS** Albert Saenger, Al's Electric, St. Cloud; and Maurice Bischoff, Cold Springs Electric, Cold Springs, find post-session huddle fruitful at recent annual meeting of Minnesota Electrical Association in Minneapolis.

# *Sudden Splash or Soaking Shower*

won't stop a Wagner® DP Motor . . .

Wagner® Type DP Motors are doubly protected by rugged, corrosion-resistant cast iron frames and dripproof enclosures. Splashing or falling liquids, corrosive acids, salts, and alkalies can't stop their smooth operation. Designed to meet a wide variety of applications— including many that used to require splashproof motors—Wagner Doubly Protected Motors pack plenty of power into precious little space, are lightweight, long-lived, and pare downtime and upkeep costs to the bone. Simply put . . . they get the job done. Let your nearby Wagner Sales Engineer show you how these motors can be applied to your needs. Call him, or write for Bulletin MU-223.

**Wagner Electric Corporation**

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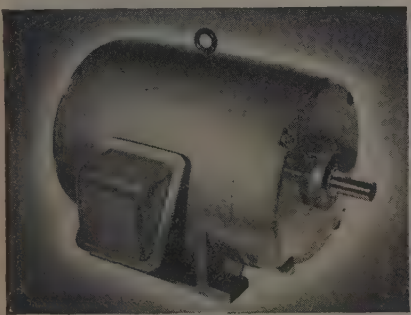

SLEEVE BEARING MODELS AVAILABLE . . . DP Motors are built in NEMA frame sizes 182 through 445U; 1 through 125 hp—1750 RPM—40°C; available with ball bearing construction as illustrated or steel-backed, babbitt-lined sleeve bearings. Larger motors (Type RP) are available through 1000 hp.

CAN BE RELUBRICATED . . . Original factory lubrication will last for many years in normal service, but openings are provided to permit the relubrication that adds years to motor life under severe conditions.

COOL RUNNING . . . Specially designed baffles direct cooling air through the motor to reduce stator temperature, thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

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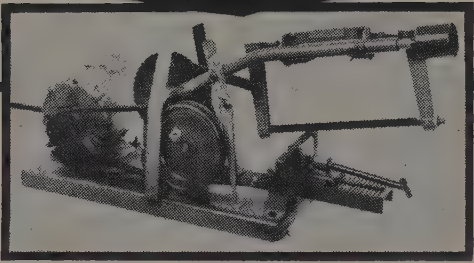
PORTABLE POWER HACKSAW



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Now with a new improved base and convenient carrying handle! Weighs only 16 pounds (Less Motor)! Easily carried to any job! Uses ordinary 10" Hacksaw blades! Cuts any metal up to 3½" thick, or pipe up to 4½" OD with vise adapter! Fully automatic, shuts itself off when cut is completed! Amazingly low priced! Satisfaction guaranteed! Thousands in use everyday.

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SOLD DIRECT FROM FACTORY
LOW COST
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The fine workmanship of the low-cost International line will be readily apparent to you and your customers . . . enabling you to beat competition and still make a longer profit! All fixtures are guaranteed to meet with your approval.

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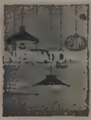

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**IN JOVIAL MOOD** following busy day of industry sessions at recent Upper Midwest Electrical Industry Convention in Minneapolis are contractor Leonard Jost, Albany Electric, Albany, Minn., and state electrical inspector Elroy Reberg, Sauk Rapids, Minn.

complete agenda subject matter included W. R. Moss, Edwards Co., Inc., Milwaukee; M. R. Guberud, Metals & Controls Co., Milwaukee; S. C. Hunt, Square D Co., Milwaukee; O. A. Cavanagh, Underwriters' Laboratories, Inc., Chicago; W. O. Zervas, American Iron & Steel Institute, New York.

## IES SW Regional at Corpus Christi

Over 200 delegates and guests attended the two-day annual conference of the Southwestern Region of the Illuminating Engineering Society, held at the Robert Driscoll Hotel in Corpus Christi, Texas, earlier this year. The recurring theme in most of the talks was, appropriately enough, lighting trends. The program also included a three-man panel of architects in which each architect gave his views on lighting in a short preliminary talk and then answered questions posed by the moderator and by the audience. In addition, the Southwestern Region IES members held a run-off of their nationally sponsored IES Applied Lighting Competition.

The meeting got under way when John B. Deck, Jr., the Society's regional vice president, of Dallas, Texas, officially opened the conference. He introduced J. L. Bates, president of the Central Power & Light Co., Corpus Christi, who welcomed the lighting engineers to his city and wished them success with their conference.

Eight speakers participated in the four technical sessions held during the two-day conference. Seven of these speakers each treated lighting trends in specific

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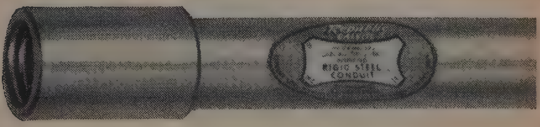
This high quality pays off in installation costs because of its uniformity, ductility, freedom from hard spots. Easy to use with clean, sharp, free-running threads, clean inside surface. Tight, hot-dipped galvanized finish will not flake, peel, or chip off.

If you want to make more profit on every job, see your electrical distributor for Republic Rigid Steel Conduit. Send for additional information.



**GALVITE® RIGID STEEL CONDUIT** (Blue Label) is a heavywall, hot-dipped galvanized conduit with a special coat of baked-on lacquer inside and out for greater corrosion-resistance and long life. ENAMELITE® Rigid Steel Conduit (Red Label) heavywall conduit is protected inside and out with a baked-on coating of tough, wear-resistant enamel for greater protection against moderate corrosive action.

This STEELMARK of the American Steel Industry tells you a product is made of steel. Look for it when you buy.

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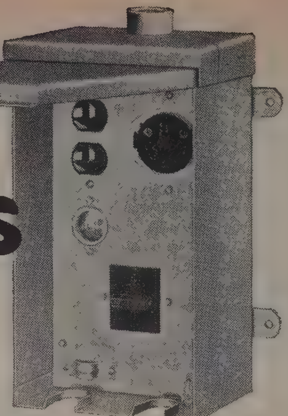

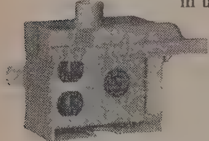

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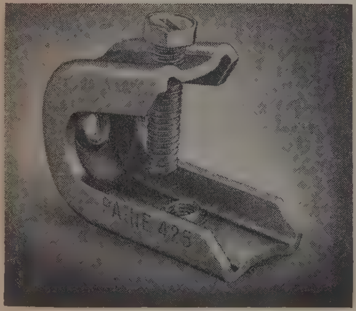

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PAINE'S New Heavy-Duty SENIOR BEAM CLAMP

Assures the fastest, easiest, most dependable universal support for heavy piping, conduits, hanger rods, etc.

- Designed for perfect, heavy-duty, flush-mounted fastening onto ceiling channel, web joists, "I" beams, etc.
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- Mates ideally with any Paine conduit clamp.
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- *Slotted* screw head makes installation faster, easier.
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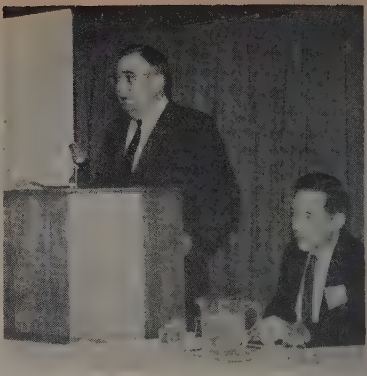


**ADDRESS** of welcome was made by J. L. Bates, President, Central Power & Light Co., Corpus Christi, Texas (at podium), to delegates attending the Southwestern Regional Conference of the Illuminating Engineering Society at the Robert Driscoll Hotel in Corpus Christi, as IES Regional Vice President John B. Deck, Jr., of Dallas, officially opens the convention.

lighting application fields, and the eighth talk was devoted to overall lighting trends in general, including market analysis and projected outlook for lighting over the next ten years.

First speaker was John S. Haney, Crouse-Hinds Co., Syracuse, N. Y., who discussed floodlighting. He outlined the new IES and NEMA floodlighting classifications. described how floodlighting calculations are made, showed color slide applications covering the five major application fields (advertising, selling, work, protection, recreation), and announced that Dr. H. R. Blackwell is currently making a study on seeing tasks outdoors in an effort to provide reliable data on which to base future outdoor lighting recommendations.

The trend to combined lighting and air conditioning systems and inherent problems in application were outlined and discussed by B. S. Benson, Jr., of the Benjamin Electric & Mfg. Co., Des Plaines, Ill.

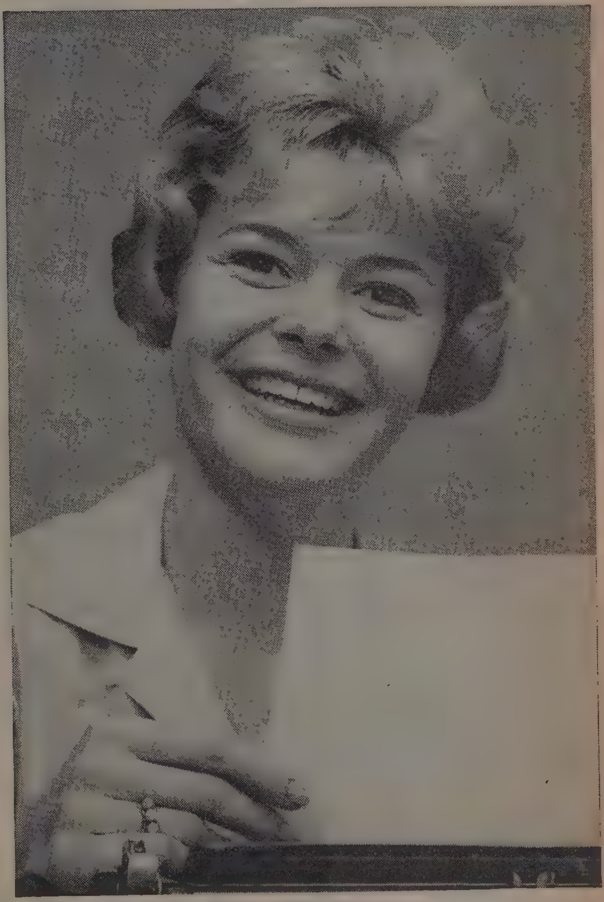
"Church Lighting—Past, Present and Future" was the title of a talk made by M. M. Terkel of Novelty Lighting Corp., Cleveland, in which he illustrated past and present trends by a series of color slides.

A valuable roundup of street and highway lighting around the world was presented by slides and discussion by William P. Lowell, Sylvania Electric Products Inc., under the title of "Roadway Lighting at Home and Abroad."

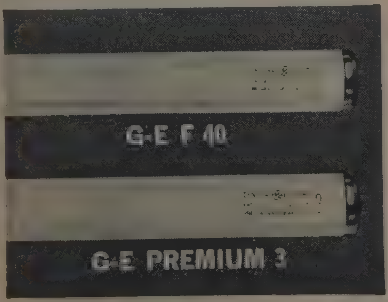
The "Lighting of Downtown Stores" to attract and keep customers within the busy city shopping areas was discussed and illustrated

# How much brighter would your customers like their secretaries?

**20%?** You can brighten their secretaries—and all their other people, too, by improving their "eye-Q" (their ability to see better, work better). If the present lamps are 1 to 3 years old, suggest replacing them with General Electric F-40 Fluorescent Lamps tonight. Tomorrow your customers will have 20-35% *more light without adding a single new fixture!* G-E F-40's work in present 40-watt fixtures whether they use starters or not, cost 5¢ less than previous rapid start lamps.



**50%?** It can happen. New G-E Premium 3 Lamps are the most powerful 40-watt fluorescents on the market and the first 40-watters to deliver over 3,000 lumens! Just replace all his 1-to-3 year old lamps with them. The higher lighting level means his people will make fewer errors; efficiency and morale will get a big boost. General Electric Premium 3 Lamps also work with or without starters. They get up to 50% more light without spending a cent on new fixtures.



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New Premium 3 and F-40 Lamps are two recent examples of how G-E research saves your customers money and gives them more light, too. And at the same time gives you the newest, most effective sales tools to work with. General Electric Co., Large Lamp Dept. C-011, Nela Park, Cleveland 12, Ohio.

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PLUGMOLD 3000, for standard single-gang box devices. Holds, without devices, up to 10 No. 6 conductors.

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PLUGMOLD 2200 serves as baseboard, multi-outlet system, perimeter raceway. Holds up to 10 No. 10.

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PLUGMOLD 2100, for Wiremold devices rated at 15A, 125V; 10A, 250V. Without devices, holds up to 5 No. 6 conductors.

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PLUGMOLD 2000 has pre-wired sections for short runs, Snapicoil for long runs. Holds 3 No. 12.

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TELEPOWER is pair of parallel Plugmold raceways, one for communications, one for power and light.

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**ARCHITECTS' PANEL** at Southwestern Regional Conference of the Illuminating Engineering Society in Corpus Christi, Texas, was moderated by Don Madden, Chairman of the Ark-La-Tex Chapter, IES. Architects who participated in "An Architect Looks at Lighting" panel were (seated, l to r): Joe G. Smyth, C. P. Donnelly, and Walter E. Wilde, all members of AIA and practicing architects in Corpus Christi.

with color slides by W. Everett Folsom, Dallas Power & Light Co., Dallas.

The current outlook on lamp bulbs and tubes was summarized by Carl Allen, of General Electric Co., Nela Park, in a talk on "Latest in Light Sources."

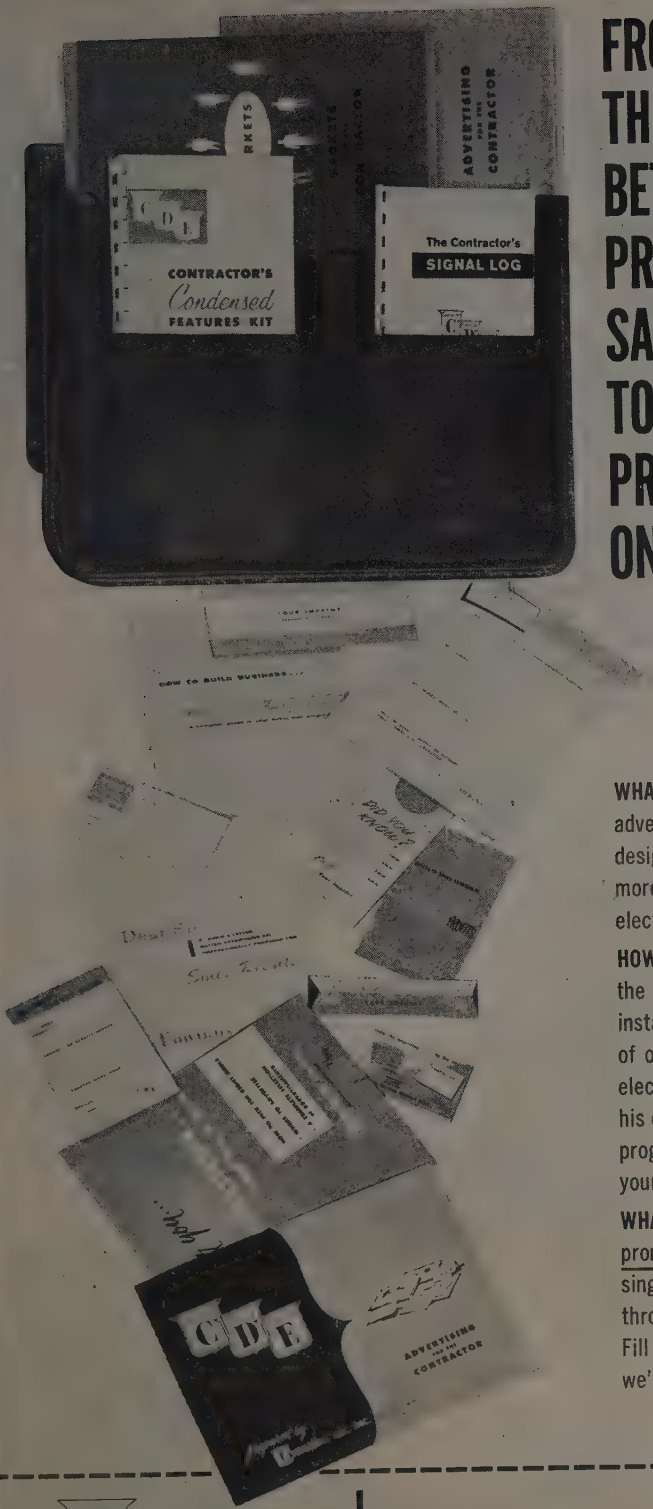
Residential lighting trends were summarized effectively by Mary Wallace, of the Texas Power & Light Co., Dallas, in which she used some excellent color slides not previously seen by IES members generally.

A roundup of "Lighting Trends in the Sizzling Sixties," including a prediction that lighting sales volume by 1970 would total about $1.4 billion, was made by Berlon C. Cooper, Associate Editor, *Electrical Construction and Maintenance*. The presentation was primarily by color slides showing lighting applications and equipment trends, also charts and tables in which market analysis data were presented.

Six prizes were awarded in the Applied Lighting Competition regional runoff contest, three prizes being awarded in each of two lighting classifications. In Class I, Residential, first prize was won by Mrs. Maxine Briggs, Hunsicker Bros., Oklahoma City, for her entry covering the lighting in a speculatively built Gold Medallion Home. Second prize went to Virginia Benson, Central Power & Light Co., Sinton, Texas, for an entry on "Modern Lighting Designed for Spacious Living." Jane Davis, Dallas Power & Light Co., Dallas, won third prize for her entry covering the lighting in the home of Dr. and Mrs. James E. Wilson in Dallas.

In Class II, Commercial-Industrial, first prize went to Dana Price, of Goleman & Rolfe, consulting engineers of Houston, for an entry covering stained glass window lighting in St. Theresa Church. Second prize went to Thomas L. Moore, Tom Moore Electric Co., Dallas, for the night lighting in the Southland Life Insurance Co. building, Dallas; and third prize was won by Patrick Dunlop, Oklahoma Gas and Electric Co., Oklahoma City, for the floodlighting of a Carillon Tower in two contrasting colors.

**NISA** members attending the 1960 Plant Maintenance Show in Philadelphia included Al Elson, Jr. (left), past-president (1957-58), President of New England Machine & Electric Co., Pawtucket, R. I., and Joe H. Previty, past-president (1955-56), and President of Penn Electric Motor Co., Philadelphia.



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**HOW WILL IT HELP YOU?** We have long considered the recognized electrical contractor who installs our equipment as an important member of our "sales team". With the great expansion in electrical work, the contractor should direct his efforts to the most profitable jobs. This program, designed to do just that, helps you set up your own sales and advertising program.

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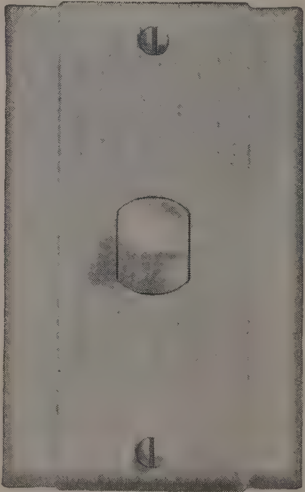
The new Coronet Apartment is the last word in style and luxury in multiple unit dwellings. Bold, sweeping lines cast tradition to the winds and produce a really fine example of architecture native to the "desert-and-sun" of Arizona.

The entire structure boasts P&S Rocker-Glo switches. Rocker-Glo, America's most-wanted switch is absolutely quiet in operation, glows-in-the-dark and is smoothly operated by pressing, rocking, rolling or simply nudging.

Rocker-Glo AC switches are designed for use on tungsten filament and fluorescent loads at full current rating. *For full information write Dept. ECM-76A.*



No. 2201 Rocker-Glo Switch

PERFORMANCE SPECIFIED

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60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario

**SPEAKERS** at the annual spring meeting of District No. 1 NECA, at Montauk, L. I., June 5 to 8, were William G. Nordling, vice president, NECA; M. E. Glennon, Jr., president, Nassau & Suffolk Chapter; Harold A. Webster, president, NECA; and Monsignor Richard Hanley.

## NECA District No. 1 Holds Spring Meeting

"Education Begets Progress" was the theme of the 14th annual spring meeting of District No. 1 of the National Electrical Contractors Association. The meeting was held at Montauk Manor, Montauk, L. I., June 5 to 8 and the registration was approximately 350.

Harold A. Webster, president, NECA, discussed industry development. He pointed out some of the problems involved with attempts to promote industry interdependence. One of the biggest problems, he said, was the clarification and understanding of the primary sales responsibility of the electrical industry in the construction market.

Mr. Webster said that the new construction, modernization, repair and maintenance volume in 1960 is estimated at $85 billion, of which more than $10 billion is the estimated installed value of products and services. This includes all the electrical material, equipment and apparatus that become parts of new buildings, facilities and the modernization, maintenance and repair of existing structures. He stressed the importance of selling and urged the members to add salesmen to their organizations in order to get their share of this business.

Problems of the industry and the association were outlined by Paul M. Geary, NECA executive vice president, Washington, D. C. He said that the annual sales volume of work done by 12,000 electrical contractors in the country is $3 billion. However, statisticians say that nearly $15 billion of electrical construction, modernization, maintenance and repair work is done annually, which is five times the volume which is presently being handled by the industry. In spite of the growth of our own dollar volume, he said, we are doing each year a smaller percentage of the total that is available to us. The average electrical contractor, he pointed out, is good at production but weak in selling and financing.

Monsignor Richard Hanley talked about "Industry and Labor Responsibility to the Public." He stressed the importance of honesty in all dealings with associates and customers. William G. Nordling, vice president, NECA, reported on the activities of the Council of Industrial Relations and the importance of arbitration.

A discussion on the relationship of inside and outside chapters on line construction work was presented by Gordon S. Heylin, vice president, Line Constructors, NECA. Dr. C. D. Phillips, management analyst, NECA, outlined the contractor development program and Joseph Felber, market analyst, NECA, discussed the "Area Market and Employment Survey" which is being conducted at the local level through the chapter managers. The purpose of the survey is to find out the market for services of electrical contractors in each area; how much of this market is being handled by NECA members; how much is being done by direct employment; and what the manpower situation is.

John B. Kiernan, manager, Nassau-Suffolk Chapter, talked about contractors as a chapter manager sees them, and Floyd Taylor of the National Research Committee District No. 1, outlined the programs of educational development available to contractors.

M. E. Glennon, president of the Nassau-Suffolk Chapter, was chairman of the business sessions.

**ATTENDING NECA** sessions at Montauk Manor were S. Freedman, Freedman Electric Co. and P. C Sellew, Sellew Electric Co., both from Hartford, Conn.

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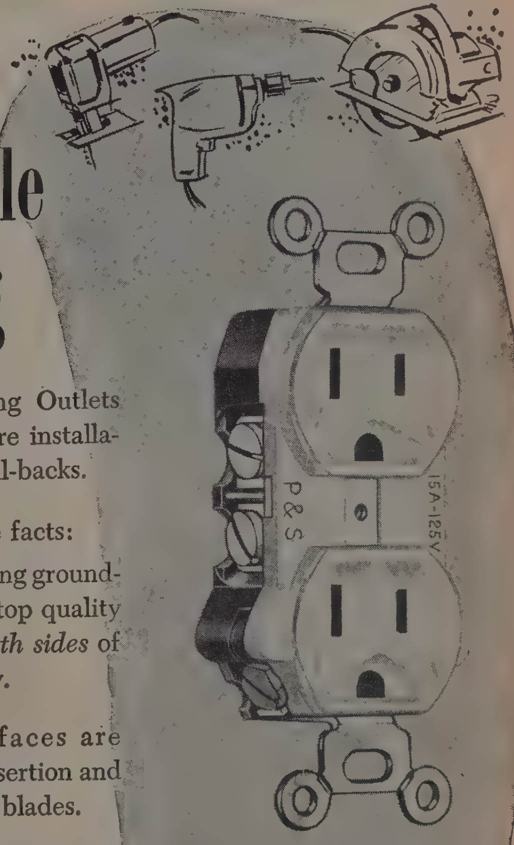

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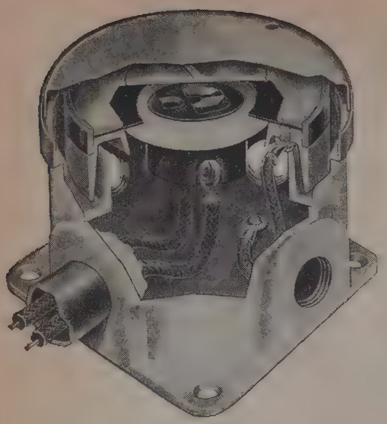

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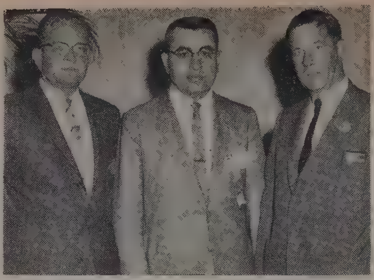

**1960 NISA** convention, held in the Fontainebleau Hotel, Miami Beach early in May, was under the general chairmanship of Michael E. Assalone (center), Florida Electric Motor Co., Miami, who was congratulated for the success of the conference, by NISA Vice-President J. Arthur Turner, Jr. (left), Tampa Armature Works, Tampa, Fla., and NISA President Horace C. Blenkhorn, Blenkhorn & Sawle, Ltd., St. Catharines, Ont., Canada.

## NISA News

Approval of a new emblem for the association was granted by the NISA board of directors at its meeting in Miami Beach, Fla., during the national convention last May.

The new emblem, to be adopted when the name of the association becomes officially "Electrical Apparatus Service Association, Inc." on April 1, 1961, shows an outline map of North and South America with the initial letters "EASA" imprinted across the center. The name of the association appears in smaller letters in a circle around the entire insignia. Below the new emblem are the words "Founded as NISA in 1933."

NISA-EASA officials are currently preparing a new catalog of EASA materials, including electrotypes of various sizes for one and two-color use, decals for truck and window displays, uniform patches, lapel buttons, and so on.

• • • •

Southwestern Chapter's new yearbook, a compilation of motor shop members in Texas, New Mexico, Oklahoma and Arizona, is available from Miss Ann Hickman, executive secretary, Box 546, Fort Worth, Texas.

• • • •

A new NISA-EASA Yearbook will be issued late in the summer. It will contain the largest number of listings of any association directory to date, more than 1,500 service firms in addition to nearly 100 suppliers and manufacturers. Details about the member firms, which are arranged geographically, include the specialties of the company (fractional repairing, rebuilt sales, etc.), the number of employees, whether it repairs appli-

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ances, portable tools, transformers, and so on, as well as information about its facilities—machine shop jobbing, for example.

Copies of this directory of nearly 200 pages, spiral bound, may be ordered in advance from the association's central office. Address: National Industrial Service Association, Inc., 7730 Carondelet Ave., St. Louis 5, Mo. Price of the yearbook is $5 a copy. Copies of the 1959-60 edition are also available for immediate shipment.

• • • •

Regional meetings of NISA-EASA chapters are scheduled to be held in Vancouver, B. C. (British Columbia, Puget Sound and Oregon Chapters) on October 21 at Grosvenor Hotel, and in Minneapolis, Minn. (North Central, Midwestern and Wisconsin chapters), September 16-17.

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A. J. Kuzniewski has been elected president of Wisconsin Chapter. Other officers are Carl Wojahn, vice-president; and Jerome Miller, secretary-treasurer.

• • • •

Three Detroit shops will be co-hosts at a meeting in August at Spaulding Electric Co., Inc., Detroit, of Great Lakes Chapter. Sponsoring the meeting with the Spaulding firm are Don Blackburn & Co. and Seneca Electric Co.

• • • •

Richard Lehr, of H. N. Crowder Jr. Co., Allentown, Pa., has been elected president of Quaker City Chapter. Other officers are: James Previty Sr., Penn Electric Motor Co., Philadelphia, first vice-president; George McDaniels, Kufen Electric Motors, Inc., Hatboro, Pa., second vice-president; Milton Eisenhardt, Pennsauken, N. J., treasurer; Frank A. Schaef, Smith

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**NEW OFFICERS** of the National Industrial Service Association (NISA) for the administrative year 1960-61, are (l. to r.): Alex A. Shovan, Industrial Electric Service Co., Hawthorne, N. J.—treasurer; B. J. Horton, The Atkinson Armature Works, Pittsburg, Kansas—secretary; J. Arthur Turner, Jr., Tampa Armature Works, Tampa, Fla.,—International president; and (not in picture George Larsen, Larsen-Hogue Electric Co., Los Angeles, Calif.,—vice-president.

of Philadelphia, Philadelphia, Pa., secretary.

Members of the chapter's executive committee are: George Wagner, Wagner Electric Service, Philadelphia; Joseph B. Roy, Roy's Electrical Service, Cheswold, Del.; Paul Secrest, S&M Electric Motor Repair, Trenton, N. J.; Thomas DiMarino, Marino Electric Co., Inc., Philadelphia, Pa.; Clarence Chandler, McHugh Electric Co., Wilmington, Del.; Charles Markley, H. N. Crowder Jr. Co., Allentown, Pa.; and Paul Duphily, Electrical Equipment and Maintenance, Milford, Del.

• • • •

A tour of the Simonds Saw & Steel Co., Fitchburg, Mass., was made by members of New England Chapter before a dinner meeting at The Old Mill, Westminster, Mass., June 9. Emerson Harris, chief en-

**MIDWESTERNERS** Charles H. Bill (l) Koontz-Wagner Electric Co., South Bend, Ind., and Joe F Ferrari, Excel Electric Service Co., Chicago, compared notes on the outlook for business in the months ahead during the recent annual convention of NISA, held in Miami Beach, Fla.

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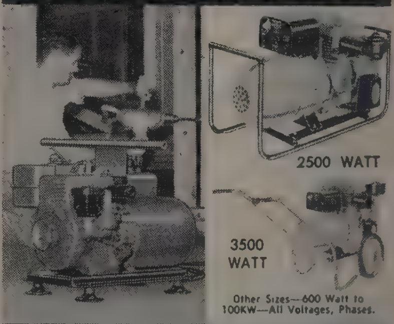

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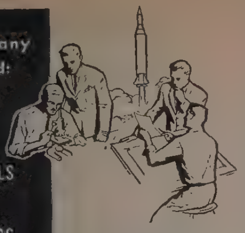

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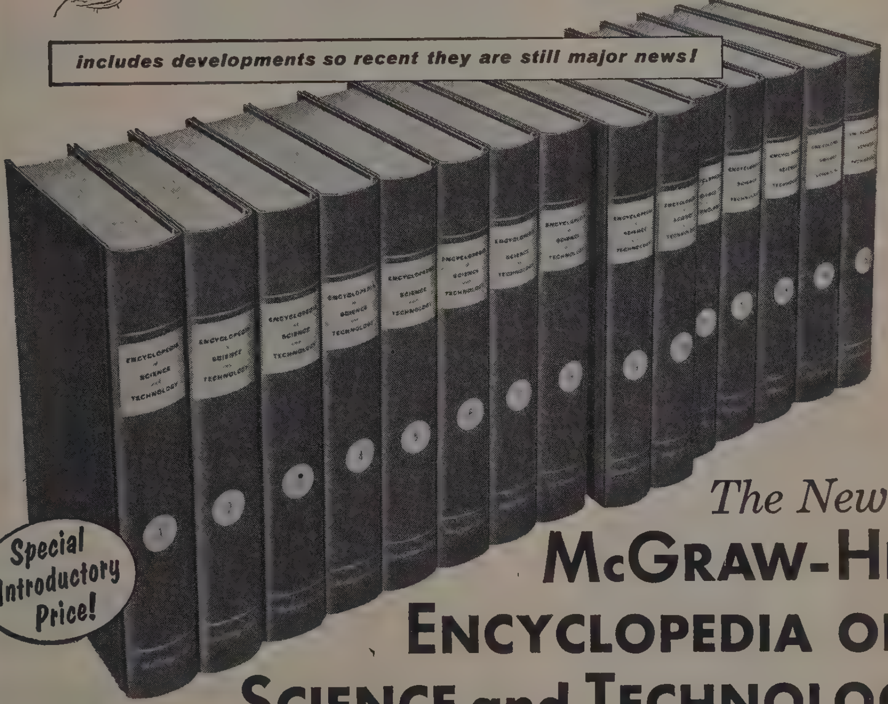

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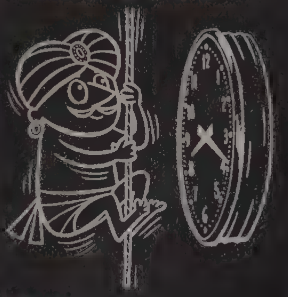

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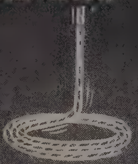

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**WEST VIRGINIANS** Richard G. Jones, Southern Industrial Marketers, (l.) and Allen D. Coppinger, Coppinger Machinery Service, both of Bluefield, have a lobby chat between business sessions at the recent annual NISA convention, held at the Fontainebleau Hotel in Miami Beach, Fla.

gineer, Simonds Saw & Steel Co., was the principal speaker.

• • • •

Stanley H. Sichel, Bache & Co., investment counselors, New York City, was the principal speaker at a dinner meeting of the New York Chapter on May 26.

• • • •

A social meeting was held at Sandy Run Country Club on June 10 by members of Quaker City Chapter.

• • • •

Lewis S. Bain has been elected president of Southeastern Chapter. Other officers are: F. E. Cook, vice-president; Roy E. Shinault, secretary-treasurer; James Shearon, Virginia director; J. Lester Belcher, Florida director; and Ben F. Whaley, South Carolina director. Mrs. Gladys R. Spurlock, Box 633, Richmond, Va., has been named executive secretary.

**PROGRAM** is reviewed by two Western delegates attending the NISA annual convention in Miami Beach recently. Holding a copy of the program is Alva E. Johnson, Johnson Electric Motor Service, Great Bend, Kansas, while William N. Pickett, Electric Motor Supply Co., Joplin, Mo., looks on.

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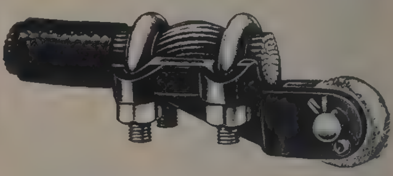

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# DATES AHEAD

**NISA Chapter Meetings — King Coal,** St. Louis, Mo., July 14; **North Central, Midwestern and Wisconsin,** Minneapolis, September 16-17; **Central Ohio,** Columbus, Ohio, September 18; **Southwestern,** Austin, Texas, September 22-24; **King Coal,** Evansville, Ind., October 13, and Mount Vernon, Ill., January 12, 1961.

**International Association of Electrical Inspectors** — Chapter Meetings — **Southern California,** Santa Barbara, Calif., July 20; NFPA Fall Conference, Columbus, Ohio, November 14-16.

**National Association of Lighting Maintenance Contractors**—National Conference, Milwaukee Inn, Milwaukee, Wis., August 22-24.

**Illuminating Engineering Society**—National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., September 11-16.

**International Association of Electrical Inspectors — Northwestern Section,** Sheraton-Portland Hotel, Portland, Ore., September 12-14; **Southwestern Section,** Mapes Hotel, Reno, Nev., September 19-22; **Eastern Section,** Wentworth-By-The-Sea, Portsmouth, N. H., September 26-28; **Western Section,** Continental Hotel, Kansas City, Mo., October 3-5; **Southern Section,** Rice Hotel, Houston, Texas, October 17-19; **Canadian Section,** Toronto, Ont., Canada, October 28-29.

**Pennsylvania Electric Assn.**—53rd annual meeting, Penn-Sheraton, Pittsburgh, Pa., September 20-22.

**The Ninth Annual National Symposium on Industrial Electronics**—Symposium jointly sponsored by AIEE and IRE, Manger Hotel, Cleveland, Ohio, September 21-22.

**American Welding Society**—Fall Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., September 26-29.

**International Association of Electrical Leagues**—25th annual conference, Hotel President, Kansas City, Mo., October 5-7.

**National Electronics Conference**—Hotel Sherman, Chicago, Ill., October 10-12.

**Florida Association of Electrical Contractors**—Annual Convention and 8th Electrical Trade Show, Deauville Hotel, Miami Beach, Fla., October 12-15.

**National Electrical Contractors Association**—1960 annual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

**American Standard Assn.**—11th National Conference on Standards, Sheraton-McAlpin Hotel, New York City, October 25-27.

**National Electrical Manufacturers Assn.**—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

**Electrical & Home Appliance Show**—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

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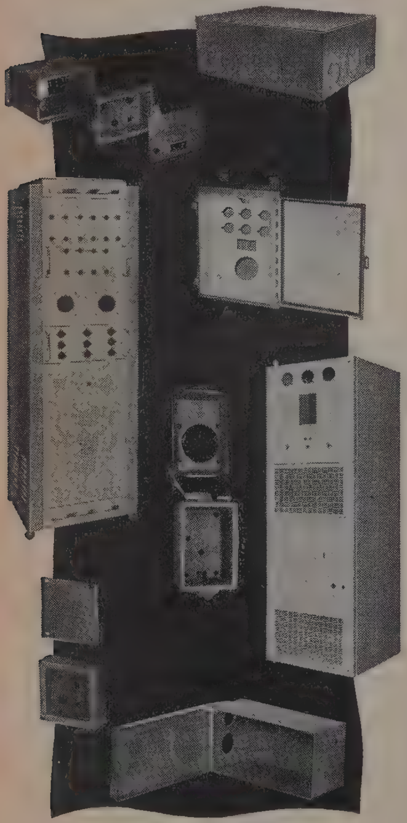

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# Among the Manufacturers

## Headquarters Announcements

**The James F. Burns Co.** has moved to its new modern plant at 1601 Industrial Highway, Pennsauken, N. J.

**Burndy Corp.,** Norwalk, Conn., has contracted to acquire the assets of Husky Products, Inc., Cincinnati, Ohio.

**Monarch Electric Corp.,** Jamestown, N. Y.—George L. Williamson, vice president—sales.

**International Rectifier Corp.,** El Segundo, Calif. — Angus Scott, sales manager.

**Kennecott Copper Corp.,** New York, N. Y.—Seymour S. Jackson, vice president.

**National Elec. Div., H. K. Porter Co., Inc.,** Pittsburgh, Pa.—Arthur J. Conley, manager of conduit and building wire sales.

**Slater Electric and Mfg. Co.,** Glen Cove, L. I., N. Y.—Francis J. Cashin, executive vice president.

**Vickers Inc.,** Detroit, Mich.—Gordon H. Clayton, vice president.

**Advance Transformer Co.,** Chicago, Ill.—E. H. Gallet, manager of distributor sales.

**The Wakefield Co.,** Vermilion, Ohio—Daniel A. Schisler, vice president — marketing; Carl A. Schroeder, vice president—production.

**Panellit Service Corp.,** Skokie, Ill.—Archer Wombacher, national sales manager.

**Daystrom, Inc.,** Murray Hill, N. J.—Harold L. Russell, product sales manager; Harry L. Peters, product engineering manager, Weston Instruments Div.; Kenneth H. Klipstein, director.

**Markel Electric Products, Inc.,** Buffalo, N. Y.—Robert H. Jacobson, assistant sales manager.

**Westinghouse Electric Corp.,** Pittsburgh, Pa.—Carl E. Cannon, product sales manager for electric heating, air conditioning div.

**Bell Electric Co.,** Chicago, Ill.—Charles E. O'Toole, general sales manager.

**General Industries Co.,** Elyria, Ohio—Harry J. Hinchliffe, vice president; John R. Perkins, sales manager.

**Exide Industrial Div., The Electric Storage Battery Co.,** Philadelphia, Pa.—C. J. Moore, vice president—marketing; Leland E. Wells, vice president—engineering.

**Controls Co. of America,** Schiller Park, Ill.—Edward Kaufholz, director of sales, Control Switch Div.

**AWARD WINNER,** L. J. Sever, senior electrical engineer and associate, Albert Kahn Associated Architects and Engineers, Detroit, won second place in the IES Great Lakes Regional Lighting Contest sponsored by 11 sectional Chapters and held in Cleveland, Ohio. His winning entry: lighting of National Bank of Detroit's new building EC&M, Nov. 1959).

**Hudson Wire Co.,** Ossining, N. Y.—James T. Simmons, general manager.

**General Electric Co.,** Plainville, Conn.—Hicks B. Waldron, manager, Distribution Assemblies Dept.

**Hitemp, Inc., subsidiary of Hitemp Wires, Inc.,** Monrovia, Calif. —William W. Crossman, manager and Robert J. Martin, sales manager.

**Arvin Industries, Inc.,** Columbus, Ind.—Joseph C. Freedland, sales manager, electric heat div.

## Regional Appointments

### NEW ENGLAND

**International Rectifier Corp.:** Ray Knox, manager of New England sales office in Cambridge.

**Gould-National Batteries, Inc.:** Richard Relf, Northeastern regional manager, Industrial Div.; headquarters in New York City.

**Sylvania Lighting Products:** Michael Balog, manager, and Daniel S. Gustin, engineer-in-charge, Manchester, N. H., plant.

### MIDDLE ATLANTIC

**International Resistance Co.:** Terry Halpern, eastern sales manager.

**The Wiremold Co.:** Philip F. McGovern, district sales manager, Metropolitan New York area.

**Wolverine Tube:** T. F. Vigmostad, sales manager, New York district.

**Gould-National Batteries, Inc.:** William B. O'Keefe, regional manager, New Jersey area, headquarters in Jersey City, N. J.

**Corning Glass Works:** Clarence W. Clarkson, Eastern sales representative, New York City area.

### SOUTH ATLANTIC

**Slater Electric & Mfg. Co.:** William F. Bishop, Atlanta, Ga., agent in Alabama and Georgia.

**I-T-E Circuit Breaker Co.:** Daniel E. McDade, manager, Charleston, W. Va. office.

**Allis-Chalmers Mfg. Co.:** Joseph M. Duncan, assistant general manager, Washington, D. C. office; Wilson O. Vaughn, manager, Baltimore district.

**S&C Electric Co.:** Roy E. Wilson Co., Atlanta, representative in Georgia.

**Rockwell Mfg. Co.:** Marion F. Huff, district sales manager, southeast district, Municipal & Utility Div.

### EAST CENTRAL

**International Resistance Co.:** Richard F. Klem, midwestern sales manager.

**Ramset Fastening System:** Eugene T. Umpleby, district sales manager for West Virginia, eastern Kentucky, southeastern Indiana and parts of Ohio.

**G&W Electric Specialty Co.:** C. D. Binning Co., Detroit, representative throughout lower Michigan.

**JOBSITE CONFERENCES** between electrical contractor, inspector and utility engineer maintained continuous "meeting of the minds" during installation period at 14-building $30-million business-shopping Lloyd Center in Portland, Ore. Snapped during one such discussion are (R-to-L) Cliff Tingley, superintendent for Lord Electric; Noel Rankin, electrical inspector for architect-engineer John Graham; and George A. Drewett, area engineer for Pacific Power and Light.

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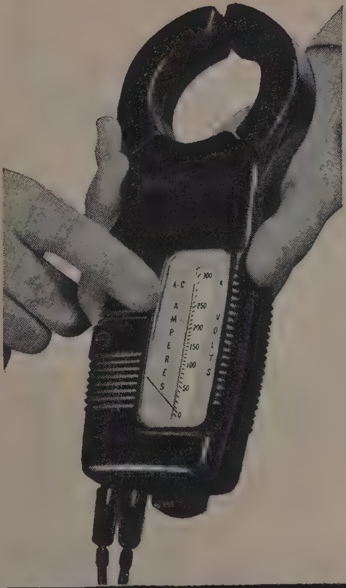

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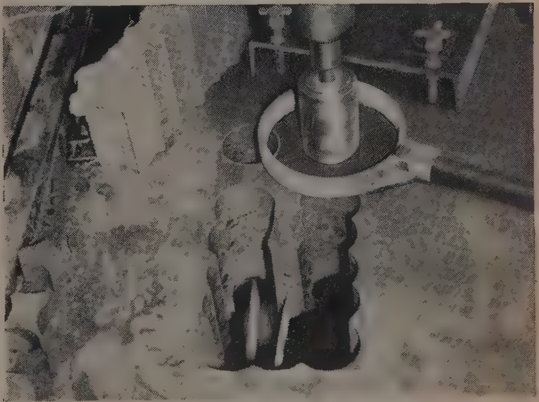

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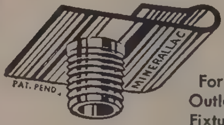

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**Wolverine Tube: Travis E. Mosier,** sales representative, Moline, Ill.

**SunSwitch Div., Ripley Co., Inc.:** Ralph D. Evans, midwestern sales manager.

**The Kirlin Co.:** F. A. Dunewald, sales representative for eastern Missouri and southern Illinois.

### WEST CENTRAL

**Fullman Mfg. Co.:** Arthur H. Swartz, Houston, sales representative for the South Texas area.

**Vickers, Inc.:** Kinrick Co., St. Louis, sales representative.

**Wolverine Tube:** T. E. Goodyear, sales manager, St. Louis district.

**Duro-Lite Lamps, Inc.:** Ralph Thomas, midwest sales representative.

### WEST

**International Resistance Co.:** Sheldon Schreiber, western sales manager; Logan & Stone Co., San Francisco, sales representative in northern California and northern Nevada.

**Ramset Fastening System:** Charles D. Maclure, district sales manager, Denver.

**Prescolite Mfg. Corp.:** Pete Wyman, sales representative, San Francisco area; John Ludlow, sales representative, Salinas, Monterey and San Francisco peninsula areas.

**Wolverine Tube:** James J. Boyett, sales representative, San Francisco district.

**Montgomery Brothers, Inc.:** Stuart L. Forsyth, general manager, comfort heating sales, San Francisco.

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## CIRCUIT BREAKER OIL-

[FROM PAGE 103]

field. This procedure offers economical and practical advantages. With the use of portable equipment, the oil in circuit breakers may be reclaimed without taking the breakers out of service by exercising necessary electrical precautions. Indeed, it has been found that circulating the oil through a reclamation set long enough will also clean the breaker components.

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Modern new oils for circuit breaker application have natural inhibitors. The advantages of adding inhibitors to new oils, therefore, are limited. Field experience has shown the feasibility of adding acid-neutralizing inhibitors to prolong the life of used oil that tested too high in neutralization number but satisfactory for other values.

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1. Symposium on Insulating Oils—Third Series, March 23, 1949—American Society for Testing Materials.
2. Rapid Spot Test Methods for the Evaluation of Used Transformer Oil. R. E. Reinhard, W. E. Elliot, E. P. Schram, AIEE Conference Paper No. 57-1145, (Allis-Chalmers Manuf. Co., Milwaukee, Wisc., Publication No. A-C 58-13.)
3. Standards of American Society for Testing Materials—Part 7, 1958.

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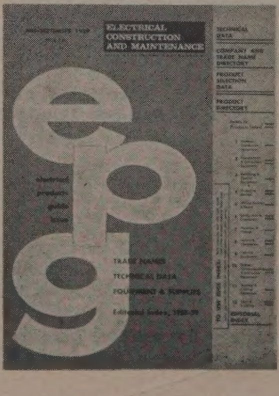

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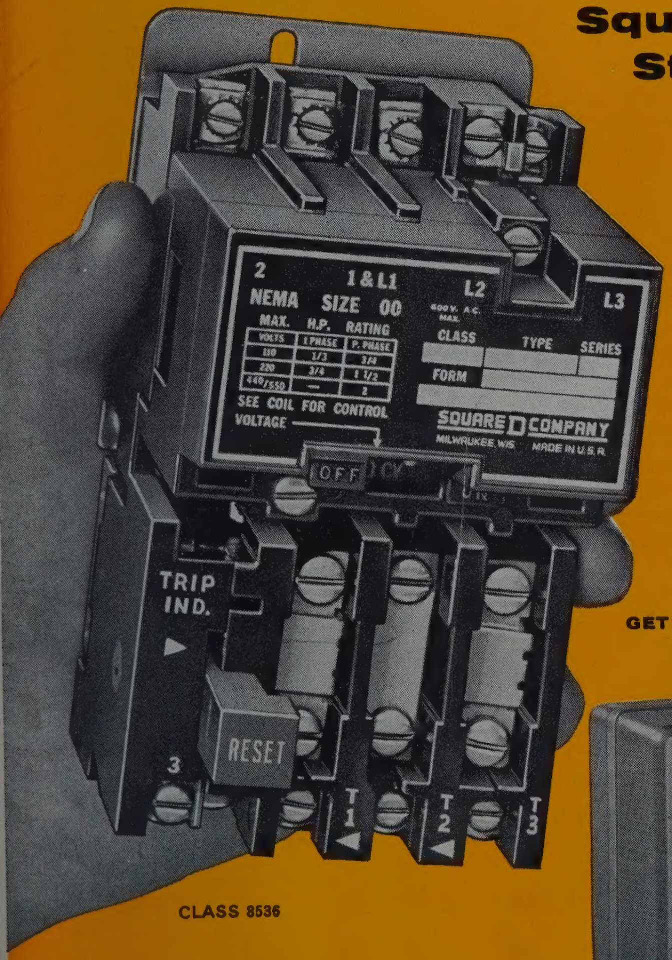

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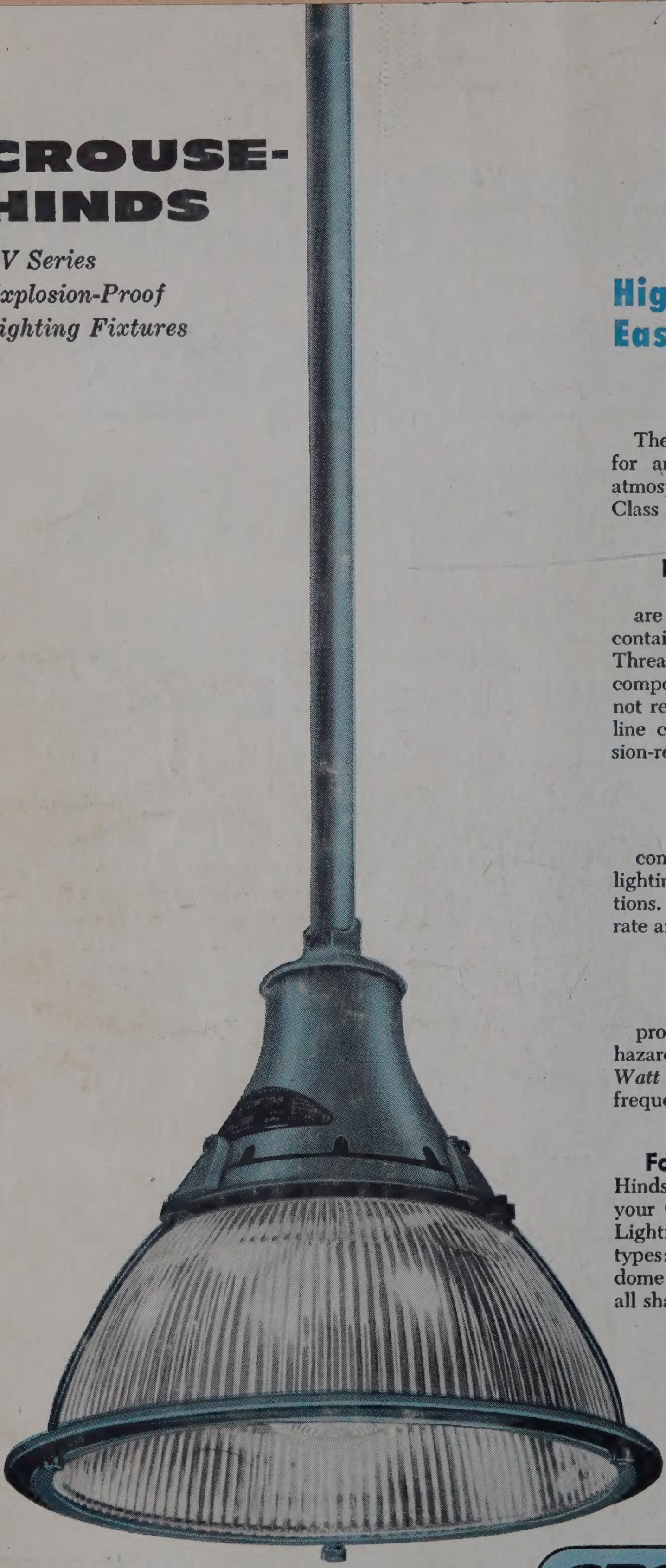

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